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Classified Advertisements—Official Notices—Tenders—Supp. 19.
Index to Advertisers—Page xl.

Principal Contents:

	PAGE
Domestic Appliance Manufacture	486
Low-voltage Neon Tubes. By P. Freedman	487
Flue-gas Cleaning Plant	488
Radio for Flying-boats	489
Normalising Rolled Steel Strip	490
The Ideal Home Exhibition	491
The Central Board's Report	493
Electricity Tariffs and Prices	494
Meetings and Discussions	495
Crossed-phase Reactive Meters. By G. W. Stubbings	496
Correspondence: Earthing and Testing; Abstruse Papers; The Single-phasing Trouble; Earthing for Heavy Currents	497
A Photo-telemetering System	498
New Apparatus and Devices	499
B.E.A.M.A. and Tariff Questions	501
Registered Electrical Contractors	501
Business and Industrial Notes	503
Electricity Supply	507
Traction and Communications	508
Contract Information	510
Notes	511
Our Personal Column	512
Financial Section	513
Published Specifications	517
New Work for Contractors	518

Electric Furnace Developments

ONE of the most promising of recent applications of electric heat in industry is in the form of resistance furnaces for normalising metals and alloys. As bright annealing depends for its success upon the exclusion of oxygen-containing gases during heating and cooling, a definite point in favour of the new technique is that atmospheres and temperatures, varying with the metals concerned, can be controlled within fine limits.

Another advantage, comparing it with the fuel-fired pot system in which the charge is sealed in heavy containers with cast-iron swarf which has to be heated and cooled and removed afterwards, is that the time required for a complete cycle is a matter of hours instead of days.

With other fuel-heating methods, the oxide has generally to be removed after the process by pickling at a cost in time and material which may amount to more than that of the annealing itself, and even with subsequent buffing the scale remaining is likely to cause wear of dies and tools. A point of much more than superficial importance is the cleanliness of electrical working, which is found to encourage accuracy in workmanship under the almost laboratory conditions obtained.

Of the two types available, the batch and the continuous, the former, which was first produced in Great Britain, finds its greatest scope where the charge is relatively massive and prolonged cooling is requisite. In one vertical-cylindrical design the elimination of oxygen is secured without an artificial gas atmosphere.

The continuous furnace, which deals with its burden in a steady flow has a remarkably short heating and cooling cycle, which gives a fine grain to the finished product. The type installed at the Stourbridge Rolling Mills at the beginning of this year and described in the present issue deals with short lengths of mild steel as well as coiled strips, and is said to be more flexible than the American furnace of the same type. While its advantages in saving of space and time are immediately obvious, it is too early to give useful figures bearing on its net savings, but the confidence that Mr. Mitchell, the chairman of the Stourbridge Co., managed to impart on the occasion of a recent visit was distinctly encouraging.

Bright annealing has possibilities beyond those offered in rolling, drawing and pressing mills—for example, fabrication by brazing in a controlled atmosphere. There should be no qualms on the ground of reliability, as the temperatures required, less than 1,000 deg. C., are well within the range of nickel-chromium elements, which should last several years.

It seems likely that those who anticipate for electric bright annealing a similar success to that achieved by the high-frequency furnace in its different sphere will not be far wrong. As with all industrial heating loads, however, a close knowledge of manufacturing conditions is especially necessary to secure preference for electricity. Engineers without first-hand experience of these would do well to take the hint given at E.D.A.'s annual meeting and make full use of the services of the Association in this connection.

Grid Research

WHILE the report of the Central Electricity Board for 1935 (reviewed in this issue) has not the same interest from the constructional aspect as some of its predecessors, it contains much of technical moment. One of the most important is the three years' programme (to be completed next year), undertaken with the co-operation of the Electrical Research Association, of practical tests of devices for mitigating the effects of lightning, which, with whipping of conductors, is the greatest source of trouble. Two or three years ago we should have added insulators, but the Board's engineers believe that a solution of the problems of operation in humid and polluted atmospheres has been found in the use of anti-fog insulators having a long leakage path and a large area of porcelain exposed to the rain. Early fears of the results of vibration in weakening the strands of aluminium conductors at their clamps appear to have been groundless, as the dampers recently fitted in every span (sometimes one at each end) of the 132-kV

lines are reported to have cured this. A new development of value is the continuous recording of the outputs of generating stations and interchange of energy between different parts of a system. This represents a notable contribution by light-current engineering to heavy-power control.

The Consumer is Right

That the plea for an approach to standardisation in tariffs is more than a desire to secure a mere neat uniformity, or even the simplicity that is essential to load development, as Mr. B. Handley urged in his I.E.E. paper last night, was indicated by Professor Miles Walker in the second paper discussed. With a grid tariff generally available, the consumer, or potential consumer, justifiably regards it as ridiculous that, owing to differences in the local management policy, the cost of electricity for a precisely similar house taking 8,000 kWh per annum—a representative figure—should be three or four times as much in some areas as in others not widely differing in characteristics.

Learning the Lesson

There is much to be learned from the Bradford inquiry in matters of technical detail, but the outstanding point is that the lay-out of the Valley Road switchgear complied with recognised practice at the time of its installation five years ago. There are many stations that are not up to the Bradford level in switchgear sectionalisation or in other ways. The reconditioning of these has to be carried out as operating exigencies allow, since they cannot be laid off. If the present inquiry results in a speeding up of the modifications necessary for compliance with the most modern standards and shows what can be done further to improve reliability in these older stations, the breakdown will have served a useful purpose. It will, no doubt, lead to a radical change of view as to what constitutes complete duplication of supply, but this may be obtainable without unreasonable expense if thought be given to it and panic measures avoided.

Important Reconstruction Work

In the course of his evidence before the House of Commons Select Committee which is dealing with the London transport Bills now before the House, Mr. Frank Pick mentioned that the Board intended to spend £2,500,000 on "putting the power houses at Lots Road and Greenwich on a more satisfactory basis." This was an alternative to purchasing energy from the Central Electricity Board, which could not offer the Transport Board sufficiently low terms, although Mr. Pick stated that eventually half of the energy required by the Transport Board would be taken from the C.E.B. The former L.C.C. Tramways power-station at Greenwich, which supplies energy for the trolley buses, is to be drastically overhauled; five of the seven existing sets are to be replaced. At present the station is equipped with 25-cycle plant, and it is probable that the new plant will consist of 50-cycle sets.

B.I. Activity

The large increase in profits earned by British Insulated Cables, Ltd., last year was attributed to two causes by Sir Alexander Roger at Tuesday's meeting. It was largely due to the economies effected through a fixed policy of ruthless scrapping of plant as it approached obsolescence, which made possible the provision of modern and extended production facilities; and it was also due to a general advance in turnover. Output exceeded all previous records, but to fasten on any one department as contributing exceptionally to the excellent result, where there are so many, was hardly possible. The company is sharing in the progress of railway electrification and expects to continue to do so. It has for some time been designing and developing a system for transmitting wireless broadcast programmes over the light and power cables, but in view of the recommendations of the Government Wireless Committee regarding relay services, its chance of exploiting its system is remote, and it is therefore placing its experiments at the disposal of the B.B.C. and the Post Office. Sir Alexander alluded to the company's active interest in facilitating the installation of electricity in both old and new houses through the medium of a company whose purpose in life was the financing of hire-purchase wiring. Experience has shown it to be a long-felt want, and orders for cables and wires have resulted.

Hire Purchase Installations

The hire-purchase question also came under notice in Mr. G. H. Nisbet's address at the annual meeting of the Midland Electric Corporation for Power Distribution, on Tuesday. As showing the extent to which this class of service is appreciated by the public it was mentioned that total advances have exceeded £100,000 since its introduction. Only £41,000 is outstanding. The company's area contains large numbers of small artisan dwellings let on rental; the demand for electricity in such houses is very real and it is met by hire-purchase installations being paid for through a separate prepayment meter at 1s. per week. The supply of domestic electrical apparatus is given on hire-purchase terms through the same collector meter. This separate meter enables the consumer to see the respective costs of installation and electricity consumed. The psychological value of this arrangement is stated to be definite. The Midland Electric added 7,822 new consumers, connected 23,000 h.p. additional demand and increased the units sold by 17 per cent. The new domestic load was over 7,000 kW. Mr. Nisbet made special mention of a number of oil engine installations in the area that have been changed over to electric drive, and of electric furnace installations in hand and in progress.

Propaganda in the Lords

If members of the House of Lords were not previously aware of E.D.A.'s "Million More" campaign they have now been enlightened. Lord Eltisley, the new President of the Association, had the task of moving the second reading of the Electricity Supply (Meters) Bill in the House last week, and in the course of his speech he referred to the fact that there were now over seven million electricity consumers, and said: "Only this year the Electrical Development Association has set out to gather in a million new consumers. Its campaign has met with remarkable success, and there is every probability that this large figure will be reached." It is evident that the President intends to lose no opportunity of bringing the work of his Association to the attention of the country, and, moreover, it is only right and proper that peers as well as people shall be electrically educated.

Reactive Metering

Methods of metering reactive volt-amperes in three-phase circuits fall into three classes, namely, those which are accurate in all conditions of voltage and current unbalance; those which will register accurately with unbalanced currents, provided the voltages are symmetrical; and the purely approximate methods, which are only strictly accurate with balanced currents and voltages. Methods of the first class require metering elements which are internally compensated for reactive VA measurement and are not commercially used. Methods of the second class require either special meters which are partially compensated, or special instrument transformers if standard three-phase energy meters are used, except in the case where the neutral of the three-phase voltages is available. Approximate methods of the third class have been devised with a view to using standard meters without additional instrument transformers; of these methods, that known as the "crossed-phase," which is described by Mr. G. W. Stubbings in this issue, seems to be the least known in this country, although it is the most accurate in its class.

Making Domestic Electrical Appliances at a Liverpool Factory. **(See next page)**

1. The polishing shop; there are no overhead drives or extraction trunks. 2. Spraying booths in the vitreous enamelling department. 3. The enamelling shop. 4. The small appliance assembly shop. 5. Automatic presses in the centralised machinery shop. 6. A line of cookers under progressive assembly on bogey trucks

Domestic Appliance Manufacture

The system at a Liverpool works

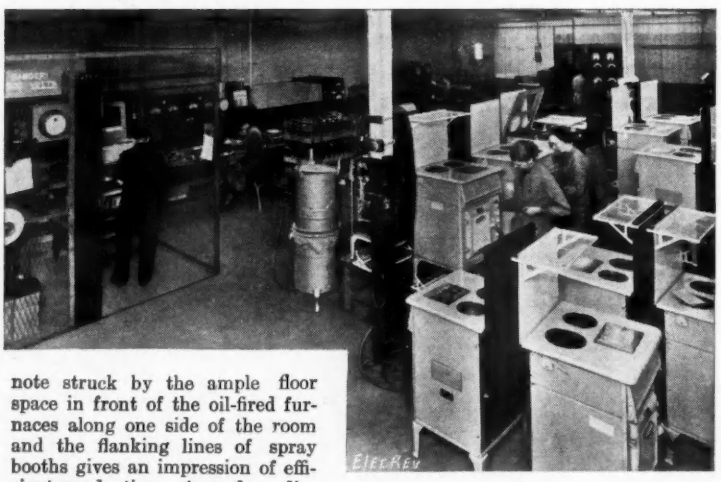
A SHORT time ago Elexcel, Ltd., was formed to carry on the domestic appliance manufacturing business of the Automatic Electric Co., Ltd., and it was later announced that as from April 1st the new company would take over the distribution of "Xcel" appliances from Siemens Electric Lamps & Supplies, Ltd., which had been responsible for this work for a number of years.

In the course of a recent visit to the works we were informed by Mr. P. M. Edinborough, managing director of Elexcel, Ltd., that both Elexcel and Siemens have for some time regarded the ultimate distribution by the manufacturing company as a "logical development," and things we saw and heard at his works certainly suggested that the manufacturers have been working to that end. The whole of the present products have been introduced within the last three years: the works has been increased in floor area by nearly 75 per cent. in the last two years; and, in readiness for April 1st, the necessary sales organisation was established by the manufacturing concern some time ago.

Spacious Shops

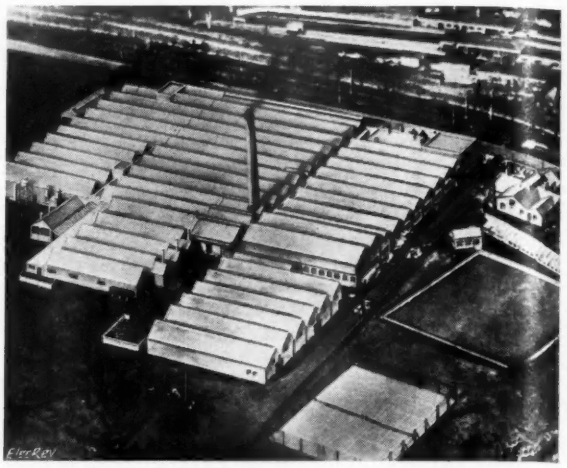
The production departments common to most of the company's wares include plating, stove enamelling, sandblasting and polishing shops. These, with a new packing section and a new stores, form the latest extension which is on the point of completion. There are some very fine plant lay-out schemes in these shops, particularly in the polishing department, where the spaciousness is particularly noticeable on account of the absence of overhead drives and extraction trunks of any description. The double-spindle incorporated-drive Canning polishing machines are each served with downward extraction trunks. The sand-blasting room with large Jackman self-contained internally operated chambers, the plating shop with a modern Canning equipment for all finishes, and the stove-enamelling shop with an efficient extraction system for the new spray booths, all tell the same story of spaciousness, but we would have liked to see *electric* drying ovens in the last-mentioned department.

A large self-contained vitreous enamelling shop, with its own milling plant, is part of the 1934 extension, but the modern



The final test room, showing the h.p. test cages

note struck by the ample floor space in front of the oil-fired furnaces along one side of the room and the flanking lines of spray booths gives an impression of efficient production. A modern dipping and cleaning room with its line of pickling, de-greasing and cleaning vats served by cradles suspended from an overhead rail that is continued right into a drying oven is another part of the 1934 extension. Centralised machining is a strong feature of the company's manufacturing system, and although this is part of the original works it is being extended by a 50 per cent. increase in floor space as the result of the complete reorganisation scheme which is coupled with the recent extensions. Castings are received from outside specialists, so that the sheet-metal department is the only other major one common to most of the products. Here we saw a Rhodes "nibbler," self-contained with its surmounted-motor and V-belt drive, which punches out small pieces of metal on a hand-guided and continuous-feed principle, and is thereby responsible for considerable production-cost savings by the elimination of press tools.



A view of the Elexcel company's Victor Works, Liverpool, from the air

From fitting the box interior to the front frame at one end of the shop to fixing the hob components at the other end, cookers are built up on special bogey trucks with rotating platforms on the line sequence mass-production principle. A feature of the cooker assembly shop is the extensive use of compressed-air portable tools including grinders, drills, screw-drivers, and so on. The trucks, which run either on the guide rails or on the floor, as desired, are taken with their loads into the test room, where the complete electrical system of each cooker is tested for two minutes at 1,000 V to earth. The company produces its own solid boiling-plates. The spiral groove on the under side of the plate casting is first loosely filled with the refractory in powder form; then a groove is impressed in the powder by a heated die, after which the element is put into position and covered with more "cement," when the whole is subjected to from forty to eighty tons total pressure in a hydraulic press complete with its geared motor drive and pump as one unit.

There are now only five standard "Xcel" domestic cookers, and whereas the normal oven construction is a fixed lining with plug-in "interior" elements, "exterior" elements and removable open-top oven interiors can be supplied. We saw the alternative arrangement in a cooker under construction for the Glasgow electricity undertaking. The bar elements are of the original open "radiant" type, built up on continuous bottom and side bus-bars.

It was interesting to note that this cooker is also equipped for automatic control, the thermostat being fitted along the top of the oven about eight inches from the front. This position gives a total differential of 12 deg., although the company is of the opinion that a differential closer than 25 deg. is not generally necessary.

There is also a neon lamp behind a port in the thermostat handle plate "more because it is asked for than for its usefulness." Automatic control can be successfully applied to any of the standard models. We saw a millers' flour-testing oven fitted for automatic control, an idea which was embodied by Elexcel in an experimental model which, we were told, has resulted in many repeat orders.

In the assembly shop for such appliances as fires, kettles and toasters we saw fire-element spirals automatically wound on machines in which spools carrying the correct length of wires revolve round the stationary mandrell after the style of those on a cable-lapping machine. For the rod-type elements the company resorts to the revolving mandrel scheme.

Among the latest fires we saw a wide range of imitation-fuel designs with the new glass-wool " fuel, and also "floodlit" models, one with three elements in "splayed" formation and one with horizontal staggered elements. It was pointed out that the reflectors are truly parabolic.

The tubular-heater shop is actually a self-contained factory. This arrangement avoids transporting long lengths of tube throughout the works at the different stages of manufacture. Even enamelling and stoving are carried out in the same shop. The tubes are made for stock complete with the element frames, but minus the actual coils, and they are completed with the coils to order

Low-voltage Neon Tubes.

By P. Freedman, B.Sc., A.M.I.E.E.

Construction and behaviour

IN an article that appeared in the ELECTRICAL REVIEW of November 22nd, 1935, mention was made of low-voltage neon tubes developed by the author to operate at normal a.c. or d.c. household supply voltages. Tube luminosity is due to the negative glow, the discharge taking place between flexible electrodes extending the entire length of the tube and linked together and spaced from each other by a large number of insulators.

Spiralised wire electrodes give particularly satisfactory results. The dimensions of the spiral are dependent upon the composition and pressure of the atmosphere within the tube, the electrode material and the condition of the electrode surface. For maximum luminous effect the negative glow should be confined to the interior of the spiral functioning as the cathode, since under these conditions the number of electrons striking the glass wall may be neglected; furthermore, the negative glow must extend so as to fill the spiral entirely.

The Gas Pressure

The gas pressure within a tube cannot be completely determined by consideration of the thickness of the negative glow, but depends upon a number of factors. Thus, an increase of pressure adds to the heat losses, while any cathode disintegration which takes place is inversely proportional to pressure. Consequently, spiral diameter is determined by the composition of the atmosphere within the tube. In this way the author found that, for neon-filled tubes, spiral electrodes of 3.7 mm. mean diameter gave very satisfactory results, but for tubes containing argon and mercury the mean diameter had to be reduced to 1.1 mm.

The reason for the difference in diameters is apparent from the table of ionisation potentials and normal cathode potential falls given below. The ionisation potential of mercury vapour is much lower than that of neon or helium, while the normal cathode fall of potential for mercury vapour is extremely high. The spiral diameter for a mercury vapour-argon mixture would be even less than 1.1 mm. were it not that the cathode fall of potential in an atmosphere of mercury vapour and argon is lower than would be expected on the basis of the arithmetic law of mixtures owing to argon cations being of much smaller mass than mercury cations.

Element.	Ionisation potential volts.	Normal cathode fall of potential for Fe cathode. Volts.
Ne	21.5	152
He	24.6	161
Ar	15.6	166
Hg	10.4	400

Spiral pitch is determined by a number of conflicting considerations. It is desirable to have the cathode area as large as possible, and that the magnetic field due to the current flowing through the spiral should be as high as possible. The amount of ionisation produced by an electron depends upon the length of its path in the dark space; when the electron is deflected by a transverse magnetic field its path may be much longer than the thickness of the normal dark space and the

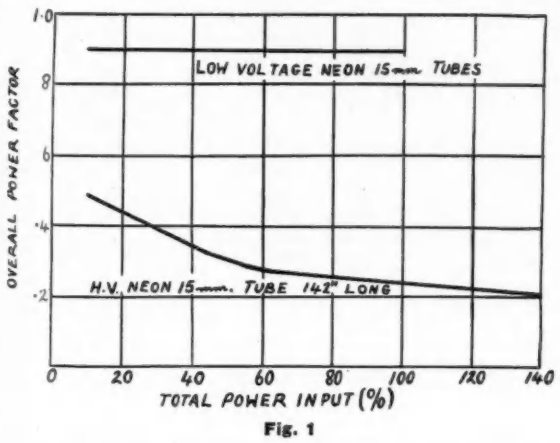


Fig. 1

ionisation produced by it much greater than when no deflecting field is present. On the other hand, decrease of spiral pitch involves an increased screening of the luminous region within the spiral. Furthermore, in order that the negative glow may extend into the space between the adjacent spiral turns, this intermediate space must exceed twice the thickness of the dark space.

Independent tests on low-voltage tubes of 15 to 16 mm. diameter show the consumption to be 7.5 to 10 W per ft. (which is of the same order as that of the high-voltage, positive-column tubes) at the maximum current corresponding to the normal cathode fall of potential. Tube voltage is independent of tube length. Tube current is nearly proportional to tube length, the departure from simple proportionality having the effect of making longer tubes more efficient than short ones.

Fig. 1 shows the high power factor of 15- to 16-mm. low-voltage tubes, compared with similar high-voltage positive-column tubes deduced from data in a paper by McMillan and Starr.[1] The power input includes the losses in the ballast resistance of the low-voltage neon and the transformer losses of the high-voltage neon. Since the voltage and current measurements were made with instruments the readings of

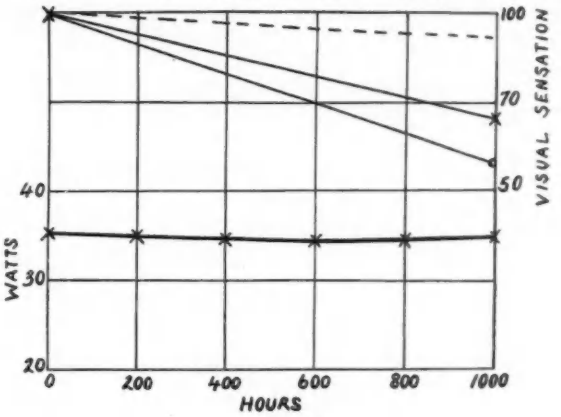


Fig. 2

which were independent of frequency (even at very high frequencies), it is clear that these tubes do not generate appreciable higher-frequency current harmonics, which in high-voltage neon cause radio disturbance.

Life Tests

Fig. 2 gives the life test curves of two tubes with oxidised iron-wire spiral electrodes. The tubes were operated at double the normal wattage (i.e., at double the maximum wattage corresponding to normal cathode fall of potential) for 1,000 hours and were intact at the end of that period. The wattage curves of the two tubes coincide. The continuous-line visual sensation curves have been deduced from the candle-power measurements by application of the Weber-Fechner law. There is no "hardening effect," and the diminution of visual sensation at the end of 1,000 hours is about 40 per cent. Since the human eye can estimate equality of luminous effects only and not their ratio, this diminution does not represent the termination of useful tube life. It was due to cathode disintegration which was to be expected under the conditions of the test. It can be deduced from J. J. Thomson's work on cathode disintegration[2] that no disintegration of oxidised-iron electrodes takes place when the discharge is normal, and, consequently, the life of a tube with such electrodes operating at normal load would be prolonged indefinitely. The dotted visual sensation curve has been deduced on the assumption that, in practice, cathode disintegration would be present even at normal cathode fall of potential, and that the amount of disintegration per coulomb at normal cathode fall would be 40 per cent. of the amount of disintegration per coulomb at double the normal wattage. The normal effective life of a good tube should therefore be not less than 5,000 hours.

Tubes have been made in both clear and opal glass and can be of any length and bent into complicated shapes. When clear glass is employed luminosity, at a distance, appears to be uniformally distributed throughout the tube, but, at close quarters, it is seen to be confined to the electrodes. This is a disadvantage in some cases, such as with neon-filled tubes, but in others, such as with blue or green tubes containing argon and mercury, the appearance at close quarters is pleasing. Tubes in opal glass in which the light is diffused over the entire surface have a satisfactory appearance both at a distance and at close quarters. The majority of tubes so far constructed have been designed to give a steady luminous effect, but pleasing scintillating effects have been produced by employing suitable gas fillings.

Theoretically, for luminous effects of the above kind, the apparent brightness of the luminous object estimated directly by the eye (i.e., on the basis of visual sensation produced) can

(1) A.I.E.E. Transactions, 1929, pp. 11-17.
(2) "Conduction of Electricity Through Gases," Vol. 2, pp. 458-469.

be represented for the given object by a hyperbolic function of the distance of object from the observer. The object would appear brighter as the observer receded, the increase being rapid at first, then more gradual, and finally approaching an asymptotic value. The luminous effect of the low-voltage tubes at close quarters is softer than that of high-voltage tubes in which luminosity is due to the positive column, but at a distance it appears similar. This quality is of particular importance, since it combines attraction at a distance with absence of eye discomfort at close quarters.

The illumination of a well-lighted shop window may vary between 7 ft. candles for a small shop to 20 ft. candles for a large shop and the reflection factor of the goods displayed may vary from about 84 per cent. for pure white down to about 6 per cent. for crimson.[3] Furthermore, the relationship between minimum brightness to produce glare and field brightness, expressed by the linear equation[4] $\log_{10} B = 3.2 + .325 \log_{10} F$, where B and F represent glare brightness and field brightness in millilamberts, does not completely indicate the condition to be observed. It is not sufficient to avoid glare; it is also necessary to produce a pleasing effect. It can be deduced from data published by Luckiesh and Holladay[5] that the value of B corresponding to a pleasant sensation is 5.75 per cent. of the value of B corresponding to a perceptibly uncomfortable sensation and only 1.7 per cent. of the value of B corresponding to a distinctly irritating sensation. High-voltage neon does not satisfy the above conditions at any luminosity which is of value as attraction at a distance.

(3) G. H. Wilson. "The Redistribution of Light," 1935.

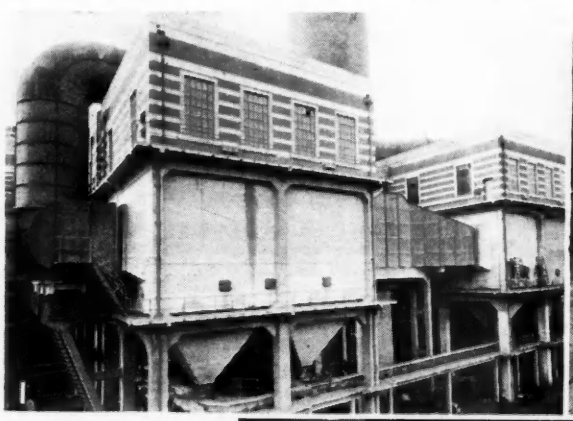
(4) Preston S. Millar and S. McK.Gray, Proc. Inst. Cong. on Illumination, 1928, pp. 239-201.

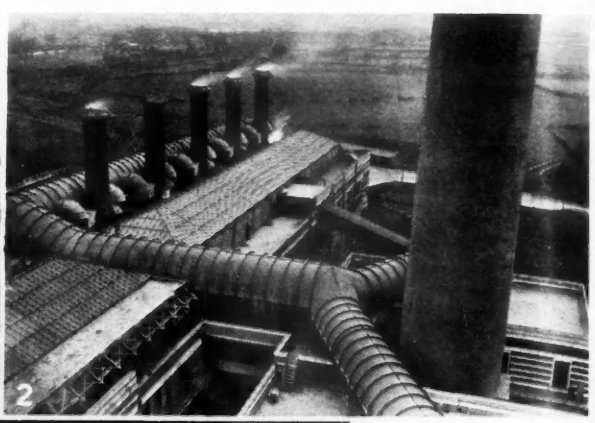
(5) Trans. I.E.S., Vol. xx, 1925, pp. 221-247.

Flue-gas Cleaning Plant

Two installations at Birmingham

ELECTRICAL flue-dust precipitation plant at the Nechells and Hams Hall power stations of the Birmingham Corporation was inspected yesterday by members of the National Smoke Abatement Society. In a preliminary descriptive lecture Mr. F. Forrest, chief engineer and manager, said that Birmingham controlled the largest municipally owned undertaking in Britain, both as regarded output and capacity.





Flue-gas Treatment Plant at Birmingham

1. The electro-filter structure and flue-gas ducts at Hams Hall. 2. The ducts connecting the boiler outlets to the electro-filter chambers at Hams Hall. 3. The rapping gear and electrode insulators above the electro-filter chambers at Nechells

The two principal generating stations were Nechells and Hams Hall. Nechells was of 156,000-kW capacity with 25 water-tube boilers, the four largest of which burned pulverised fuel, the others having mechanical stokers. Last winter coal was consumed at the rate of 85 tons per hour, of which 31 tons per hour was pulverised.

Hams Hall was of 90,000-kW capacity and extensions now in hand would increase the figure to 240,000 kW. The six water-tube boilers, each of 200,000 lb. per hour, used powdered coal and two similar ones were now being added. Last winter coal was consumed at the rate of 70 tons per hour, which would be increased to 100 tons when the new boilers were ready. Between the boilers and chimneys centrifugal grit arrestors were installed, which proved to be highly efficient in the case of the mechanically fired boilers, but not nearly so efficient with the very fine dust discharged from the pulverised fuel boilers.

The conclusions of the Electricity Commissioners' Flue-dust Abatement Committee's report coincided almost exactly with the information and advice Mr. Forrest obtained during visits to America, Germany, and other parts of Europe. Consequently it was decided to install electro-filters combined with tall chimneys, costing £200,000, for use in connection with the pulverised fuel boilers only at both Nechells and Hams Hall, the existing centrifugal grit arrestors being used alone on the stoker-fired boilers at Nechells.

At Nechells the unlined brick chimney was 350 ft. tall and of 15 ft. internal diameter at the top. It weighed 4,200 tons with a base area of 950 sq. ft. on ferro-concrete piles. At Hams Hall there were to be two brick chimneys, 350 ft. high and of 20 ft. internal diameter at the top, each weighing 5,200 tons and standing on mass concrete foundations. One was in use and the other half completed.

The existing short steel chimneys were removed and ducts provided for conveying the flue gases from the boilers to the cleaning plant while the stations were in full operation. The circular duct was made of mild steel plate 0.25 in. thick, stiffened internally, and so supported on the roof that gases from the existing boilers could be admitted to it by means of dampers. At Hams Hall this duct would be 300 ft. long and of varying diameter up to 19 ft. Expansion stresses due to changes of temperature were an important consideration.

High Guaranteed Efficiency

The contractor was required to guarantee that the efficiency of dust collection at Nechells and Hams Hall would be not less than 90 per cent. and 92 per cent. respectively when operating at full duty, while the dust content of the inlet gases was one grain per cu. ft. and 1.25 grains respectively at the actual temperature entering the plant, i.e., the dust content of the outlet gases after passing through either plant should not ex-

ceed 0.1 grain per cu. ft. corrected to the temperature of the gas entering the plant.

As the electro-filter plant worked in series with the original centrifugal-type dust arrestors, which were known to have efficiencies of 75 per cent. at Nechells and 65 per cent. at Hams Hall, the total efficiency of dust elimination between the boiler and the atmosphere had to be at least 97.5 per cent. at Nechells and 97.2 per cent. at Hams Hall. The maximum quantity and temperature of the dust-laden gases to be treated were specified to be at Princes Station, Nechells, 396,000 cu. ft. per minute at 388 deg. F., and at Hams Hall 880,000 cu. ft. at 315 deg. F. The size of the particles to be dealt with varied from 2 per cent. of over 63 microns diameter to 75 per cent. of less than 10 microns diameter.

Four separate reinforced concrete chambers, mounted on roller bearings and free to move, received the whole of the flue gases. In them the dust-collecting electrodes were installed, but any chamber could be isolated by inlet and outlet dampers, when the load on the boilers fell or for cleaning.

The gases normally passed horizontally through the four chambers in parallel on their way to the chimney. The hopper bottoms in which the dust collected had valves to enable the dust to be removed. Each chamber housed four banks of vertically suspended and electrically charged electrodes arranged in alternate rows, forming "curtains" through which the gases must pass. The negatively charged electrodes were built up of rods about ¼ in. diameter spaced at about 5 in. centres, the distance between the rows being 10 in. Twenty rows with 13 electrodes in each were provided in each bank. Midway between the negatively charged electrodes were rows of positively charged electrodes upon which the dust collected, consisting of tubes of ⅜ in. total diameter spaced at 2 in. centres with 10 in. between the rows.

Each bank of collecting electrodes had separate individual rapping gear electrically operated by motors, which regularly hammered them to shake off the dust.

The rapping hammers were cam operated, spring loaded and driven by chain gearing. The electrodes were energised by d.c. at 40,000 V.

The electrical control equipment was in a separate building remote from the treater chambers, and comprised three complete rectifying units with transformers. Two were always in operation, while the third acted as standby. Any rectifying unit could be switched on to either of the groups of electrodes, but no two rectifiers were operated together with the same bank of electrodes. Audible warning of the operation of automatic circuit-breakers and safety interlocking arrangements was provided.

Theory of Operation

In the Lodge-Cottrell plant, as in use at Nechells and Hams Hall, the electrode from which the discharge took place was always of negative polarity, and the suspended dust particles becoming negatively charged by the bombardment of the electrons in the ionised gas were repelled by the negative electrode, and attracted to and deposited upon the positive electrode.

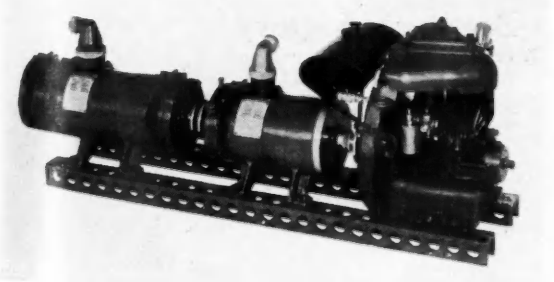
A special single-phase oil-immersed transformer having a ratio of 400 to 60,000 V at 50 cycles per second, by means of voltage regulators on the primary side, delivered current at the requisite voltage to a motor-driven rectifier. This consisted of a rotating insulated disc mounted on the shaft of a synchronous motor running at 1,500 r.p.m. Close to the periphery of the disc were four stationary terminals spaced 90 deg. apart, the top terminal being connected to the high voltage lead to the electrodes and the bottom terminal earthed, while the two horizontally mounted terminals were connected to the h.v. winding of the transformer.

On the edge of the rotating insulated disc were four contacts 90 deg. apart, adjacent pairs being connected together, which during rotation periodically bridged across adjacent pairs of stationary terminals, so that unidirectional impulses were received in the h.v. lead to the electrodes. Choke coils were employed to limit the effect of surges in the h.v. circuit.

Radio for Flying-boats

TWENTY-EIGHT large flying-boats are being built at the Rochester seaplane factory in Kent for the Empire services of Imperial Airways, Ltd. The wireless equipment for these machines is being constructed at the aircraft establishment of Marconi's Wireless Telegraph Co., Ltd., at Hackbridge, near Croydon. These radio sets are of the "A.D. 57a/58a" type. So as to economise in size and weight, the direction-finder sets will be combined with the receiver, and not arranged as a separate unit as has been the case hitherto. The wave-lengths are from 16-75 metres to 600-1,100 metres for transmission, and from 16-75 metres to 600-2,000 metres for reception.

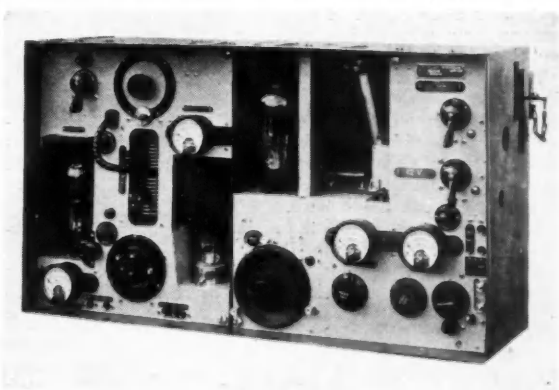
The high speed of the new flying-boats (they will be capable of just on 200 miles an hour) has made it necessary to exercise all possible care in eliminating wind resistance. The aerials, for example, are being arranged to reduce drag as much as possible. The set will have three aerials. A trailing aerial will be used when the machine is in flight. It will be



The power generating plant for the new Empire flying boats

led out through a retractable fairlead which can be projected through the hull when the aerial is being let out, and withdrawn within the hull when not required, an automatic trap-door sealing up the aperture as soon as the aerial has been wound up and the fairlead pulled in. The second aerial will be of the fore-and-aft type, running from a king-post above the wireless compartment to the tail. This will be used when the trailing aerial has been wound in preparatory to landing, or when the flying-boat is on the water. The third aerial is a direction-finding loop aerial; to reduce wind-resistance when not in use the loop will be housed inside the hull of the machine, a trap-door enabling it to be raised as required.

Another method of eliminating wind resistance will be adopted in connection with the generator supplying power for



The short- and medium-wave transmitter

the wireless sets. Instead of the usual external wind-driven generator, an internal power-supply system has been designed by the Marconi Co. along lines suggested by Mr. H. L. Hall, chief engineer of Imperial Airways, Ltd. A dynamo is coupled to each of two of the four main engines of the flying-boat, and their output is used to charge a 24-V battery. This serves to light the flying-boat and also to drive the self-starters of the main engines. The accumulator also drives a motor-generator which provides both high and low voltages for the wireless equipment.

A stand-by is provided in the form of a small single-cylinder petrol engine for driving the generator in emergency. The total weight of the wireless outfit is about 235 lb.

The Batti-Wallahs

The usual monthly luncheon of the Batti-Wallahs' Society on March 26th was the first to be held under the chairmanship of the new president, Lieut.-Col. W. A. Vignoles. The principal guest was Sir Clement D. M. Hindley, whose address dealt with "Horse Racing and the Tote." Sir Clement presides over the Board which has established totalisators on most of the more important courses in this country. Col. Sir T. F. Purves proposed a vote of thanks.

Normalising Rolled Steel Strip

A continuous-type furnace at Stourbridge

WE have recently been afforded an opportunity of inspecting the first plant installed by Birmingham Electric Furnaces, Ltd., the continuous bright-annealing of hot and cold rolled steel strip. This furnace, which is installed at Stourbridge Rolling Mills, is designed to deal with either coiled strip, which is drawn through the furnace in continuous length and re-coiled through the discharge end, or straight lengths of strip and sheets.

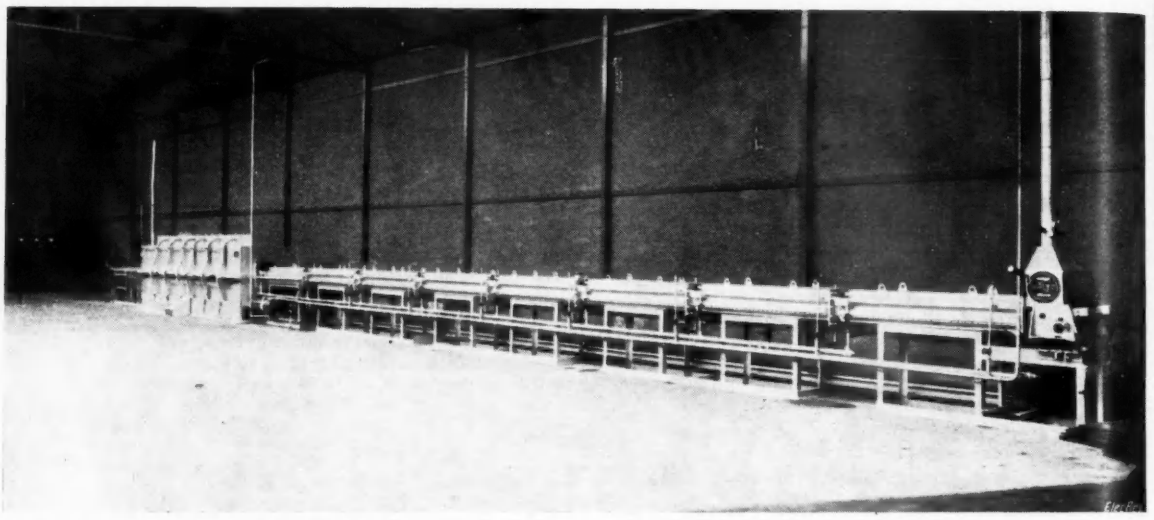
Its hourly output is 6 cwt. of material of from 0.020 in. to 0.25 in. in thickness and up to 12 in. in width, but it is readily adaptable for dealing with wider and heavier material. A number of narrow strips can be passed through the furnace simultaneously, side by side, or thin material can be handled in two or more layers. Two other models are made by the company, one with an hourly output of 10 cwt. of 18-in. strip and the other of 15 cwt. of 24-in. strip.

The heating chamber has a total loading of 80 kW and is divided into three sections, in which nickel-chromium strip elements are supported on the roof and on the floor. The temperature in each section is independently maintained constant at the predetermined value by a combined automatic regulator and indicator, which permits the rate of heating to be graded through the furnace.

Electricity is taken from the mains of the Shropshire, Worcestershire and Staffordshire Power Co. at 400 V two-phase, one phase being used to supply the top heating and the other the bottom heating. Provision against overheating is by means of fusible metal on the furnace. The furnace is joined to a water-jacketed cooling chamber forming a continuous tunnel. The outer jacket is gas-tight and the end openings are the minimum for the passage of the work.

Closely spaced rollers throughout the length of the equipment (those in the heating chamber are of nickel-chromium) are driven by a 3-h.p. motor through gearing having a speed range of six to one, by means of which the rate of travel can be controlled according to the thickness of the charge.

The furnace atmosphere is provided by a "Birlec" generator, in which controlled quantities of coal gas and air are burned; the products of combustion (the volume of which is about three times that of the raw gas) are purified of sulphur in a two-stage process and cooled and dried before admission to the furnace. This atmosphere is slightly combustible, as it contains carbon monoxide, carbon dioxide, hydrogen and nitrogen. It has a reducing effect, and its composition can be varied to suit the material under treatment. At each egress of the furnace the combustible gas escaping is burned.



The "Birlec" continuous bright annealing furnace for hot or cold rolled steel strip at the Stourbridge Rolling Mills

The total time taken for normalising the material is approximately one hour. An estimate of the cost of operating this furnace continuously during a twenty-four hour day for seven days a week was given us as 10s. 6d. per ton of steel normalised at 910 deg. C. This amount was made up of 235 kWh at 0.5d. per kWh (9s. 9d.), and 900 cu. ft. of gas for the atmosphere derived from 300 cu. ft. of coal gas at 2s. 6d. per 1,000 cu. ft. (9d.). The cost would be higher for working by day only, as the energy used in heating up the oven would have to be taken into account.

Further Evidence at the Bradford Inquiry

THE Electricity Commissioners' inquiry into the failure of supply at Bradford on February 24th, the opening of which on March 27th was reported on page 462 of our last issue, was resumed the following day. Mr. H. W. Clothier (director, A. Reyrolle & Co., Ltd.), giving evidence, said that he considered the switchgear installed by the Corporation to have been well sectionalised in accordance with recognised practice. The protection between the floor and the cables below it was appreciably above the average, and the depth of oil on the floor would have to be 3 in. before it could get into the basement. He believed that very little oil would get through the cable hole of the affected switch until the cable itself had been badly burned from below. The material of the insulator was excellent, but the small size of the opening into which fixing cement had to be poured led to the use of a cement that required a considerable amount of water; this was the only instance in which this method, which resulted in the presence of moisture behind the insulator, had been adopted.

On the occurrence of a surge at 6.9 p.m. on February 24th the insulator failed; the flames from oil and gas escaping through burnt-out portions played on the bus-bar orifice immediately above, damaging its insulation. All the switches appeared to have operated correctly and those returned to the works showed no traces of abnormal arcing at the contacts, and the damage was comparatively restricted in amount. The only evidence of electrical breakdown was on the "Y" group feeder, and he suggested that flames said to have been observed elsewhere were due to reflection in the sides of other panels. The key to the final failure was the flame below and not above the switch. Some switches must have stayed in for an appreciable time, thus allowing the turbines or the grid to feed enormous currents into a fault.

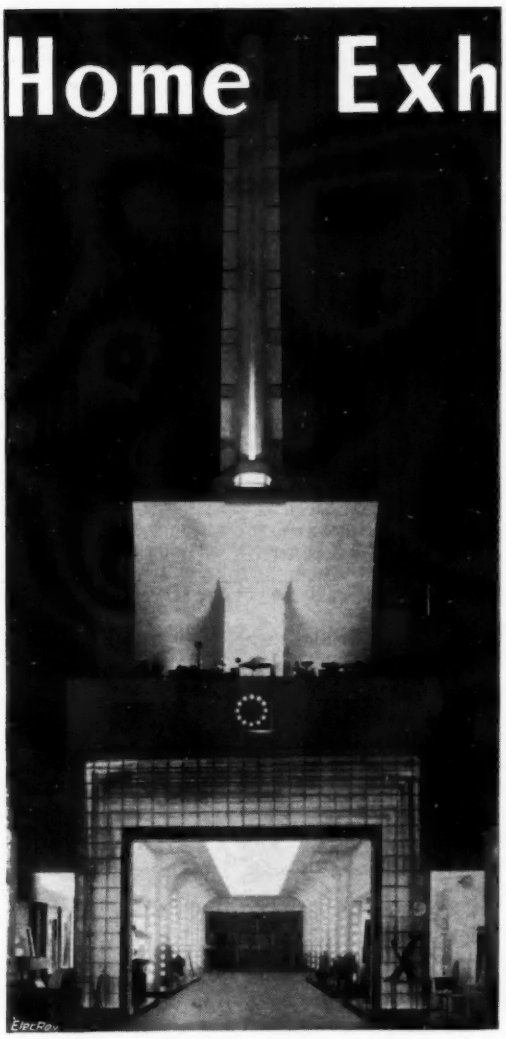
His impression was that the cables in the basement were set on fire by burning oil which got through the floor at another switch, although it might have been due to the cables being disconnected by heat in the switch and pulled through the floor opening while burning. He thought the damage to the insulator and in the bus-bar orifice occurred simultaneously. The burning out of the leads of the grid earthing transformer caused a two-phase fault to the tank, which brought out everything. The earth current then flowing might have been up to 40,000 A.

Mr. J. Hacking (deputy engineer, C.E.B.) thought it probable that the fault started on group feeder "Y" current transformer and affected the bus-bars. From these 100 gal. of oil might have been released to add to the burning oil on the ground, thus causing an explosion which produced an earth on the grid transformer switch. The layout of the switchgear at Valley Road when installed five years ago was in accordance with established practice. The Inspector (Mr. H. Nimmo) adjourned the inquiry until April 2nd.

Ideal Home Exhibition

THE Electrical Section at this year's Ideal Home Exhibition now being held at Olympia, London, is the best we have seen and is so situated in the centre of the "City of Beautiful Night" in the main hall that most visitors gravitate towards it within a few minutes of entering the building. Once there the British Electrical Development Association makes certain that they will not depart without appreciating at least some of the advantages of electricity by entertaining them with an amusing little marionette show and with film cartoons.

On each side of the miniature stage E.D.A. has arranged what it calls the "Unit Parade," indicating the cleanliness and comfort derived from the use of domestic electrical appliances, full particulars of which are obtainable from two information bureaux alongside. A central switch panel controlling the whole of the electrical apparatus, comprising cooker, kettle, water heater, wash-boiler, iron, refrigerator, radio set, a fire over the door, lights above the cooker and wash-boiler, and variable-speed extractor fans over the cooker and sink, is a novel feature of a typical small-sized all-electric kitchen, every inch of which is used to good advantage. Under the sink is a towel dryer, while the door of the vacuum-cleaner cupboard accommodates an ironing board.



The imposing exterior of the E.D.A. display

In the adjoining dining-room recess a similar panel controls the lighting and the power points for a toaster and coffee percolator, as well as the radio set and the thermostatically controlled tubular heaters. At the rear of the E.D.A. stand, on either side of a display of some of the smaller domestic appliances mounted on wooden panels, are special sections where electric cooking and water heating are continuously demonstrated.

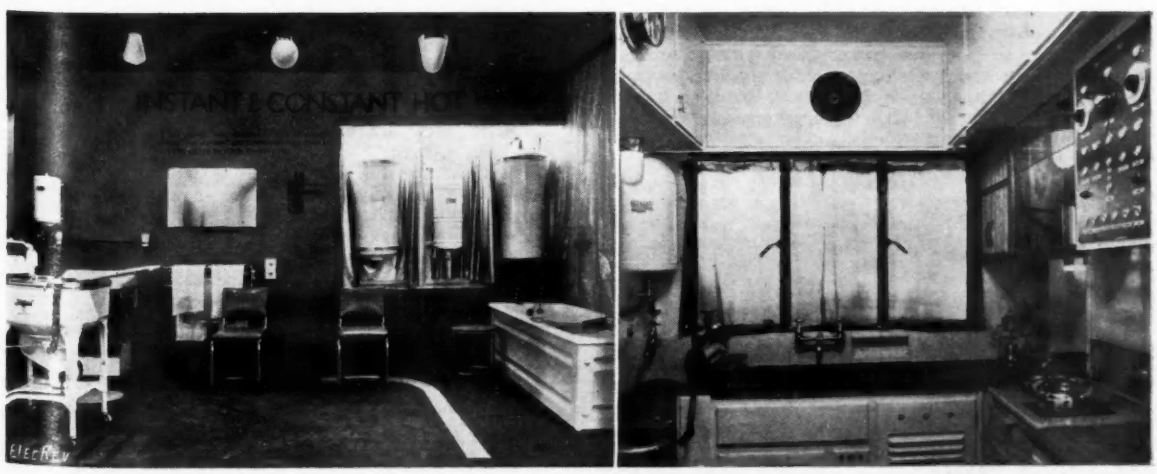
The fact that the whole of the daylight in the "City of Beautiful Night" has been blacked out by dark velvet gives manufacturers of lighting equipment a singularly good opportunity for displaying their products to full advantage. Prominent at the entrance of the "Tunnel of Light" leading to the E.D.A. exhibit are the Electric Lamp Manufacturers' Association's two stands, where, in addition to representative types of modern lamps, including the study lamp, are exhibits indicating the advantages of its members' products.

"Miss Elma" sketching on the blackboard and a light-sight tester enabling the public to measure the light required for comfortable vision and eyesight preservation, are other attractions.

On the Crompton Parkinson stand a novel demonstration shows the additional light available from the use of the coiled-coil filament lamps.

Several new lighting fittings make their appearance for the first time, among them being glareless dining-room units of silk or parchment made by Dernier & Hamlyn, Ltd., who are also introducing a small amount of crystal glass into a number of their latest models. Wall brackets incorporating architectural lamps, a heater-light pendant and a study lamp are now available from Harcourts, Ltd., and a variety of new fittings are shown by Falk, Stadelmann & Co., Ltd., and Berry's Electric, Ltd. "Boula" silvered reflector lamps illuminate the stand of the Interoven Stove Co., Ltd., actually there are fittings made from olive-oil bottles and syrup jars in the "Next to Nothing Bungalow," where most of the furniture, &c., is made from scrap.

The attractive decorative effect produced by the use of architectural lamps is emphasised on quite a number of stands, and examples of the way in which these lamps can be formed into letters are included in the exhibit of the Edison Swan Electric Co., Ltd., which is also exhibiting stereoscopic displays suitable for both home decoration and advertising. As well as indicating some of the domestic uses of these lamps, the British Thomson-Houston Co., Ltd., demonstrates, by means of a series of miniature model rooms, various artistic applications of Mazda lamps. In common with numerous other exhibitors the B.T.H. also has a model of the *Queen Mary*, the lighting being dimmer operated.



The water heating demonstration section of the E.D.A. stand and (right) the model kitchen showing the central switchboard controlling twenty-two appliances

"Osira" colour floodlighting lamps employed for cornice lighting are incorporated in the General Electric Co.'s exhibit, which, in fact, has been designed especially to show the different methods of illumination now available for the householder. The centre section of this company's wedge-shaped stand is devoted entirely to the display of lighting fittings, the remainder being used for cooking demonstrations and to introduce the new low-priced vacuum cleaner described on page 500 of this issue.

The cooking demonstration section, which is illuminated by architectural lamps recessed in the ceiling, seats fifty persons, and it is expected that 7,000 people will see the demonstrations during the course of the exhibition. One further G.E.C. attraction is a perspective view of a London street equipped with "Osira" lighting.

The drop curtain of the marionette theatre featuring the "I'm Electric" symbol

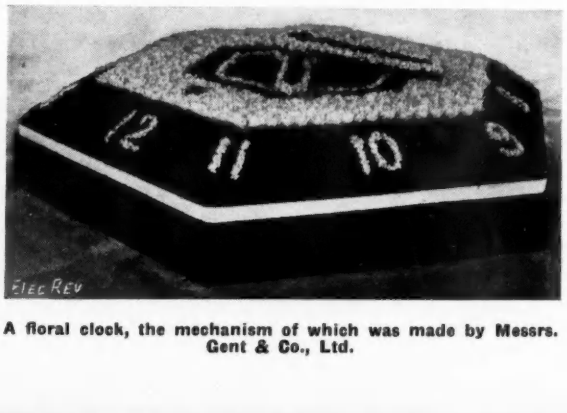
Many of our old friends in fires appear slightly modified or available in different colours; for instance, the "Haloberry" made by Berry's Electric, Ltd., is now obtainable with decorative side-pieces. A model made specially for placing in a corner is a new Falk, Stadelmann line, while the "Cobra" chromium-plated bowl fire is the Hotpoint Electric Appliance Co.'s latest development.

As usual, Messrs. Belling & Co. have a representative display, and a selection of electric radiators is to be found in Messrs. Bratt Colbran's exhibit. The "Dayanite," a newcomer among electric radiators, is a development of the Dayanite Radiators oil stove, and incorporates a 600-W immersion heater which transmits heat *via* water to hollow metal vanes. Another new fire, combining the merits of radiated and convected heat, is the "Bi-Heat Duplex" heater manufactured by Messrs. Bertram Thomas. The "Dulrae" system of thermostatically controlled low temperature warming is demonstrated by Messrs. Richard Crittall & Co., Ltd., who are just introducing a portable air-conditioning plant and a panel-type electric bed-warmer which fits under the mattress.

With the exception of the new G.E.C. model referred to above and the British Vacuum Cleaner & Engineering Co.'s new "Goblin Ace" described in our last week's issue (page 463), all the vacuum cleaners shown are too well known for us to describe in detail, and the housewife would be indeed hard to please who could not find a model to suit her among those to be seen on the stands of the Hotpoint Electric Appliance Co., Ltd.; Edison Swan Electric Co., Ltd.; Vactric, Ltd.; New Welbeck, Ltd.; British Electric Domestic Appliances, Ltd.; Ismay Rawson, Ltd.; Tellus Super Vacuum Cleaner, Ltd.; Hoover, Ltd.; Falk, Stadelmann & Co., Ltd.; and Electrolux, Ltd. On one of the two Hoover stands is displayed some of the actual apparatus used in the company's engineering and testing laboratories at Perivale. A moderate-priced built-in vacuum cleaning system is demonstrated by Centro-Vac, Ltd.

In the Kitchen

Cookers fitted with "Tem-set" automatic oven control figure prominently on Belling & Co.'s stand, where the "Baby Belling" cooker is also on view, and other models attracting a good deal of attention are the G.E.C. "Magnet" and the Falk, Stadelmann "Efesca Servis." On one side of the Hotpoint Co.'s well-planned exhibit is a model kitchen, completely furnished in yellow, with a cooker fitted with "Torribar" radiant boiling plates, a washing machine and ironer, drying cabinet, dish-washing machine and "Bandolero" fan. Among a host of other kitchen and general domestic appliances on this company's main stand the new glass-sided toaster makes its first appearance at this exhibition.



A floral clock, the mechanism of which was made by Messrs. Gent & Co., Ltd.

A new stainless-steel griller and toaster incorporating six 750-W coil-type elements and a new 3½-kW hot-cupboard, are innovations by Messrs. Richard Crittall & Co., Ltd., whose electrically driven potato-peeling machine is claimed not to bruise the vegetables. Electric buffets and plate warmers are exhibited by Messrs. Bertram Thomas. A big demand is reported for the new "Swan" "Pyrex" demonstration-model kettle made by Bulpitt & Sons, Ltd., who have also just introduced a "Pyrex" coffee percolator and a range of bakelite hot-water jugs. Demonstrations of the "Mixmaster" kitchen equipment and the "Silver Queen" electric ice-cream freezer are given by Messrs. S. Guitermann & Co., Ltd. Messrs. Corfield-Sigg, Ltd., have a representative selection of cooking utensils, &c.

Two and a half pints of water for making tea, &c., can be brought to the boil in two minutes by using the new Berry "Quicksafe" auto-boiler attachment for fitting to any 1½- or 3-gal. water heater; it is described in detail on page 499.

For small houses or flats where space has to be considered the small "Washbury" washing machine (shown by Messrs. Falk, Stadelmann) has much to be said for it. Full-sized machines of various designs are demonstrated by Servis Electric Washers; Ismay Rawson, Ltd. ("Connor"); Hurley Machine Co. (England), Ltd.; Beatty Bros., Ltd.; Hotpoint Electric Appliance Co., Ltd.; and "Easy" Washers & Ironers.

A portion of the E.D.A. "Unit Parade"

Conspicuous among the electric irons is the new H.M.V. thermostatically controlled "streamlined" model.

During the past year there has been a definite indication that this country is becoming increasingly "refrigerator-minded," and, encouraged by the prospects of the 1936 season, manufacturers of this apparatus have filled not only the large section allocated to them on the ground floor but have spread upstairs as well, Messrs. A. J. Balcombe, Ltd., showing the "Crosley Shelvador" models in the Miscellaneous Section, and Zerozone, Ltd., a recently formed company, occupying a stand in the Food and Cookery Section. The following exhibitors are showing refrigerators: H.M.V. Household Appliances, Ltd.; Zeros (Sales), Ltd.; Searsint, Ltd.; Frigidaire, Ltd.; International Refrigerator Co., Ltd.; Kelvinator, Ltd.; Coldair, Ltd.; Lightfoot Refrigerator Co., Ltd.; Berry's Electric, Ltd.; and the Pressed Steel Co., Ltd. The new "Bedal Aerofrige" models are shown by British Electric Domestic Appliances, Ltd.

Miscellaneous exhibits include the "Telerazor" (Norma Technical Products, Ltd.), a portable trouser press (W. T. Driver) and domestic health appliances (Ideal Home Electrical Appliances, Ltd.). Twenty-six electric clocks, many incorporating neon tubing, have been installed throughout the exhibition buildings by Bulle Products, Ltd.

The lighting medium of the centre glass arch in the "City of Beautiful Night" and the "Fountain of Light" in the "Hall of the Film Stars" was provided by E. S. S. Signs, Ltd. In the Housing Section, Signcrafts have carried out a number of decorative neon installations.

The talking clock, which is soon to be available to telephone subscribers in London, is attracting much attention in the extensive Post Office exhibit, which includes large-scale models and cinema films describing the radio-telephone service.

The Central Board's Report

Progress during 1935

THE eighth annual report of the Central Electricity Board, which was issued on Wednesday (Whitchurch Morris, Ltd., 1s.), covers the year ended December 31st, 1935, during which 17,565 million kWh was generated in public supply stations—an increase of 2,100 million kWh over 1934. Since 1929, the expansion of output in Great Britain has been 70 per cent. compared with 20 per cent. for the world. The output is in excess of the estimates of the Electricity Commissioners when preparing the grid schemes.

By the end of 1935, the grid system comprised 4,075 miles of transmission line, of which 2,880 miles are operated at 132 kV; 280 switching and transforming stations with an aggregate transformer capacity of 8,862,700 kVA (including 453,100 kVA added during the year); and 132 selected stations containing 6,749,230 kW of generating plant.

Extensions included the completion of the Colchester-Clacton-Frinton-Harwich-Colchester secondary ring and a new secondary line from Three Bridges to East Grinstead, a total of 50.5 miles. Eight secondary sub-stations were brought into operation, and tappings were provided on the 33-kV Berwickshire ring to assist rural development. Supplies to the Southern Railway necessitated the installation of additional equipment at Eastbourne and Hastings and the making of arrangements at Byfleet and Wymering for the London-Portsmouth electrification.

Rapid growth of load on the 33-kV system in South Lincolnshire has entailed the putting in hand of a 132-kV transforming station on the Peterborough-Lincoln primary line at Bourne to supersede the 33-kV connection with Peterborough. Similar conditions prevailed on the 33-kV network fed from Croydon *via* Epsom and a 132-kV transforming station is being constructed at Leatherhead on the Wimbledon-Woking primary line. Preliminary work has begun on forty-five miles of 132-kV lines from Ironbridge to Stoke-on-Trent and from Stourbridge to Worcester and on sixty-five miles of 33-kV lines in four sections.

New generating plant of 277,000-kW capacity was brought into commission, the most important items of which were the 105,000-kW set at Battersea (L.P. Co.), two 30,000-kW sets at Tir John (Swansea), and 57,000-kW at Tongland and Glenlee power stations (Galloway Water Power Co.). The three other stations (45,000 kW) at Carsfad, Earlstoun and Kendoon of the Galloway Co., are expected to be ready next August; the first section of the Fulham station (120,000 kW) is also approaching completion.

For meeting the load in 1937-38 directions have been issued for extensions at selected stations of 670,000 kW of generating plant and additional boilers with a total evaporative capacity of 8,000,000 lb. per hr. The most important of these are two 50,000-kW sets for Dalmarnock, one each of the same size at Clarence Dock, Hams Hall and Barton, and a third 60,000-kW set at Fulham. In addition a 33,000-kW and a 20,000-kW set is to be installed in Brimsdown (old) station; the smaller unit will take steam at the boiler pressure of 1,900 lb. per sq. in. and exhaust into the other at 160 lb. per sq. in.—the pressure of the existing boilers. The total capital cost of the extensions is estimated at £8,000,000.

Standardisation of Frequency

Frequency standardisation has required work on the premises of 340,000 consumers while maintaining their supplies. By the end of the year about 670,000 kW (out of 914,000 kW) of generating plant, 82,000 motors aggregating 1,452,000 h.p. (out of 1,822,000 h.p.), and 291,000 kW (out of 339,000 kW) of converting plant had been changed over. It is anticipated that the work will be completed by the middle of 1937.

Investigations carried out in conjunction with the Electrical Research Association have included field tests on the value of protective devices in reducing stresses imposed by voltage surges of varied magnitude and steepness. They have also determined the protective value of expulsion and Deion gaps in preventing line flash-over.

A technique has been developed at the Board's insulator research station at Croydon which enables the performance of insulators to be measured in rain, fog and polluted atmospheres. This not only enables the most suitable design for any area to be chosen, but also indicates the intervals at which insulators should be cleaned and the rate of deterioration of the different types used. There were no flash-overs due to fog where these anti-fog insulators have been installed. Permanent insulator-washing equipment has been installed in several sub-stations that are exposed to polluted or salt-laden situations. Tests on aluminium-steel conductors which have been exposed in service to corrosive influences indicate that deterioration is slow and that the steel cores have suffered inappreciably.

Much of the progress in design and construction of heavy-duty h.v. circuit-breakers has been made possible by the testing equipment in manufacturers' works. Improvements have been principally in the more rapid clearance of faults by the adoption of lighter operating mechanisms subject to increased opening forces, which secure a higher speed of parting of the fixed and moving contacts, and also of control devices that ensure rapid and consistent extinction of the arcs. Current-limiting reactors are to be installed this year at Northfleet, Wimbledon and Willesden, on the 132-kV system, and at Stepney and Islington on the London 66-kV cable system. The Board is trading generally in all areas except in N.E. England, where frequency standardisation is still in progress, in S. Scotland, where the Galloway hydro-electric works are not completed, and in N. Scotland, for which no grid scheme is in contemplation.

The Central Board's insulator testing tower at Croydon

A brief summary is given of the conditions of trading as applied to selected stations, which have the option of being charged for energy repurchased from the Board at the grid tariff or at the cost of production adjusted to load factor and power factor with the addition of a proportion of the expenses providing the grid. Section 13 of the 1926 Act guarantees the owner of a selected station against paying more than the costs that would have been incurred under independent operation, including the provision of spare plant. A method of pooling the savings due to the grid among undertakings in N.W. England and N. Wales has been devised, and the application of the method to other areas is being considered.

The owner of a non-selected station cannot be compelled to close down his station and purchase his supplies from the grid unless the cost of grid supply (excluding capital charges) is less than that of independent generation. Temporary arrangements to continue non-selected stations in operation have been made with twenty-nine undertakings.

The saving in capital expenditure in 1935 through the release of plant held in reserve under individual operation but now available for normal service, is estimated at £2,400,000, making the total saving due to the employment of formerly spare plant £11,400,000.

The 148 stations operating under the directions of the Board in trading areas produced over 95 per cent. of the energy generated by public undertakings in those areas. Only twenty-eight ran for 8,760 hours, and forty-six were operated for less than 2,400 hours. Fifteen of the base-load stations produced more than half of the total output. The average fuel consumption per kWh sent out was 11 per cent. less in 1935 than under independent operation in 1932; this represents a saving of £920,000 in operating costs in 1935.

The maximum amount which the Board is empowered to borrow remained at £60,000,000 and the stocks issued at £50,000,000 at the end of 1935, but £3,500,000 of 3½ per cent. stock was issued at par on February 11th last. The Board has not applied to the Treasury for a guarantee for any of the stocks issued. Interest on money borrowed having been paid out of capital has not been charged in the account, which shows a credit balance of £1,021,221 for the second year of trading.

A summary of the accounts is presented in an Appendix of five pages. Other appendices give particulars of the directions issued for additional generating plant, the standard form of grid tariff, a comparison of the regional grid tariffs, a list of non-selected stations operated under the directions of the Board, and statistics relating to the eight regional schemes.

Electricity Tariffs and Prices

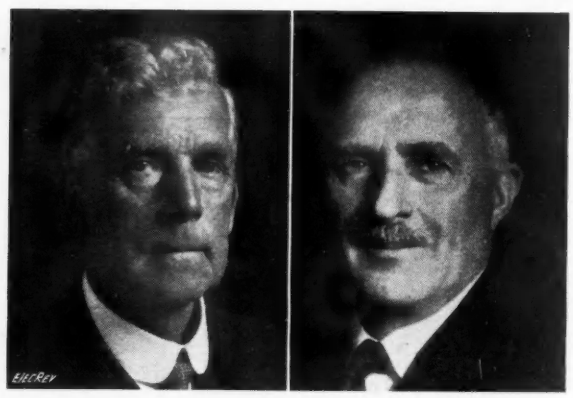
The viewpoints of a borough electrical engineer and a consumer

TWO short papers were considered at the April 2nd meeting of the Institution of Electrical Engineers in London. The first, by Mr. B. Handley, advocates a reasonable standardisation of tariffs for domestic and business premises, even if it is admitted that complete standardisation is not yet feasible. A two-part tariff is suggested for domestic use, with the fixed portion of the charge based on the size or rateable value of the house, in spite of the fact that neither method is strictly equitable. The author considers that the time is opportune for the general adoption of such a tariff by all supply undertakings, since he considers that delay (due to searching for a more scientific or equitable system) will be detrimental to the industry.

In Mr. Handley's undertaking (Portsmouth Corporation) only a very insignificant minority of consumers is now taking supplies at the old flat rate. The fact that the latter has not been excessively lowered has helped to bring this about. He feels that the two-part tariff should be used and referred to as the principal one for domestic dwellings. It should be put down first on the list and the old flat rate (which should be termed the "alternative tariff") last. He has based his fixed charges on the size of houses, as he considers it unwise to link the sale of energy with the quesstion of rateable value, which is liable to cause so much public ferment. Nevertheless, he considers that to base the standing charge on rateable value is an excellent system, and he says it is doubtful whether any good purpose would be served by abandoning it in an effort to arrive at complete standardisation.

Prepayment Consumers

It is suggested that the domestic two-part tariff should be offered to prepayment consumers on the same terms as to others. Meter charges and higher prices to prepayment consumers can be justified on economic grounds, but Mr. Handley thinks it advisable to avoid public displeasure by refraining from making these additions.



[*Lafayette* [*Margaret Ellsmoor*

Professor Miles Walker, of Manchester University, and Mr. B. Handley, city electrical engineer of Portsmouth

Opponents of domestic two-part tariffs have instanced examples of consumers who habitually put on an excessive load during the peak period of the system. Such consumers are no doubt being supplied at a loss, but anyone who anticipates that a profit is always to be made out of every individual consumer is likely to be disappointed. The subject should be viewed upon the broader basis of a whole class of consumers rather than individuals.

The maximum-demand system is a suitable means of applying a two-part tariff to lighting supplies for shops, hotels, and business premises generally, while, tucked away in the background and to comply with legal requirements, there can be an alternative flat rate.

Price Inequality

The second paper, by Prof. Miles Walker, draws attention (from the consumer's point of view and somewhat trenchantly at times) to the inequality of prices charged to consumers of electricity in various districts where charges would be expected to be about the same.

It is a matter of policy, enlightenment, or the good intention of those in control of the undertaking. That this is so, says Prof. Walker, is clearly proved in those towns (cited by the author) where a change in the ownership of the undertaking has brought about a reversal of policy from that of charging the highest price which consumers will pay to that of supplying at the lowest possible price.

For instance, when the company-owned undertaking at Oxford was taken over by the municipality courage was needed to reduce prices to less than one third for large domestic users. Mains were changed over and new ones laid in preparation for intensive domestic development. The result was that in 1935 the number of kWh sold was 46 per cent. greater than in the corresponding period of 1934, while in the June, 1935, quarter, there was an increase of 79 per cent. over the corresponding period of the previous year. The net income earned was a greater percentage of the total capital involved than when prices were high. In other words, if the company had had the courage to reduce the prices "from almost the highest in the country to almost the lowest for that kind of district," it would have been able (provided it had managed as well as the Corporation) to pay a slightly larger dividend.

Another undertaking from which a useful lesson can be learned is that of the Electricity Board for Northern Ireland, which charges uniform rates over the whole of its area (except in one remote district). Consumers who live in towns pay a little more than they otherwise would do in order that those who live in the country can enjoy the really low prices that are offered to all. The Herne Bay and Gravesend undertakings are others which point to good possibilities for the whole country.

To show how high and unfair the charges are in some places as compared with others, the author examines the cost of electricity for sample houses, including his own large house, under various tariffs. He suggests that an effort should be made to supply the whole country at prices for domestic supply, fixed at not more than 10 per cent. of the rateable value of the house, plus 0.5d. per kWh in winter and 0.35d. per kWh in summer.

Size of House Basis Not Favoured

Just because the house happens to be a large one the consumer has, in some districts, to pay prices more than twice as great as in other districts possessing no greater facilities. Therefore, Prof. Walker does not favour basing the fixed portion of the two-part tariff on the size of house or wattage installed. He says that a percentage on the rateable value is probably the fairest method and the most likely to lead to a wide use of electricity. The rateable value of a house is considered to be a rough indication of the occupier's ability to pay a standing charge. Everyone living in a district where cheap electricity is available is said to be under a moral obligation to contribute something towards the capital cost and management cost of that service, just as he is expected to pay rates for other amenities under public control.

The author looks forward to the time when almost every house in the kingdom will be connected to the grid. The total rateable value might be about £250 millions. Six per cent. of that sum would yield a total standing charge of £15 millions, which, he says, would be ample for a well-managed system free from "watered" capital and unnecessary salaries.

Demand Could be Doubled

It is probable that if powers were given to a central distributing authority to supply electricity direct from the grid, prices could be reduced below those now charged in Northern Ireland and the demand would soon be more than doubled. In 1934 the amount of electricity supplied by authorised undertakings amounted to 15,000 million kWh. If that total were doubled, one-tenth of a penny per kWh would yield £12.5 millions per year, which would be sufficient to pay 3.5 per cent. on an increase of £357 millions in the capital involved. This is much more than the increase in capital required for an extension of the distribution system, even if carried to remote country districts.

Low prices will not pay unless the load and load-factor are greatly increased, while new mains will be needed to carry the extra load. If distribution were carried out on a national scale the load factor could be improved by establishing some hundreds of battery-charging stations at distances not greater than 10 miles apart. Electric vehicles could be built to accommodate driving batteries of a standard size, so that after travelling for, say, twenty miles, vehicles could exchange their run-down batteries for newly charged ones.

Much could also be done by the more common use of maximum demand devices to prevent certain types of apparatus being used together at the same time, except by closing a special switch that would cause the meter to register at a higher rate.

Load-factor is so important that the closest attention should be given to it. One of the greatest chances of reducing the price of electricity lies in its improvement.

Meetings and Discussions

High-frequency Measuring Instruments

Measurement at High Frequencies

THREE short papers were considered at the April 1st meeting of the Wireless Section of the INSTITUTION OF ELECTRICAL ENGINEERS in London, the instruments described in each of them having been developed in the laboratories of the City and Guilds (Engineering) College, South Kensington. For the delineation of frequency/response curves of electrical and acoustic circuits the conventional point-by-point method is quite satisfactory, but becomes tedious when a large number of investigations have to be made, and an improved form of response-curve projection apparatus is described in the first paper, by Mr. D. G. REID.

The apparatus consists of a beat-frequency oscillator and cathode-ray oscillograph combination so arranged that the frequency of the oscillator output is rapidly varied over a limited range without appreciable change in amplitude, and, after passing through the apparatus whose response curve is to be measured, is applied to the vertical deflector plates of the oscillograph, the horizontal deflection being proportional to the frequency.

A frequency scale is obtained on the oscillograph by means of piezo-electric crystals, so that the calibration of the instrument is unaffected by variations in supply voltages, &c. The variation of frequency is obtained by electrical means instead of by the usual rotating condenser, and the absence of mechanically moving parts renders the apparatus compact and portable.

The second paper, by Prof. C. L. FORTESCUE, contains an account of advances made in the theory and design of screened hot-wire ammeters for frequencies of from 25 to 100 megacycles. These instruments, since first described by the author in the I.E.E. *Journal* in 1930, have been improved both mechanically and electrically, leading to greater compactness and a lower impedance of the hot wire, which is an alloy containing 33 per cent. platinum and 67 per cent. silver.

These results have been brought about by more careful consideration of the temperature distribution in the hot wire, the behaviour of the mechanical magnifying system, and the correctness necessary at high frequencies.

The third paper, also by Prof. C. L. Fortescue (see I.E.E. *Journal*, September, 1935), deals with the thermionic type of peak voltmeter for use at frequencies of the order of 20 megacycles or higher. Two sources of error are referred to, namely, resonance and the time of flight of the electrons from anode to cathode in the rectifying diode valve, which is associated with a reservoir condenser as part of the static voltmeter. In the case of a parallel-plane diode this time of flight appears to impose the severer limitation and must therefore be made as small as possible.

An approximate method of estimating the error due to this cause with diodes of other geometric form is suggested, and a convenient arrangement of portable peak voltmeter for use at high frequencies is described.

* * *

Trolley-bus Considerations

London Trolley-buses

AT the informal meeting of the INSTITUTION OF ELECTRICAL ENGINEERS in London on March 23rd Mr. J. H. PARKER opened a discussion on "Electricity Supply to, and the Equipment of, Trolley-buses," with special reference to the London Passenger Transport Board's large tramway conversion scheme. Mr. Parker said that in his opinion it was quite unnecessary to earth the overhead line on the negative side. He considered that it should be run completely insulated and if either side went down to earth it would be at earth potential, while the other side was at 600 V above earth potential. He stated that the Ministry of Transport had agreed that both lines might be insulated.

A skate collector had been adopted for trolley buses. It was absolutely essential that this should be lubricated, and graphite had been found to offer the best solution. A small-section trolley wire had been adopted which meant more cables or more sub-stations for a 1½-minute service in each direction. The sub-stations had been placed two miles apart with feeders at every half mile. This proved to be the cheapest method. The capacity of the sub-stations had been standardised at 500 kW. The glass bulb rectifiers had been fitted in a frame which had been made large enough to take the next size bulbs if required. This would put up the capacity to 750 kW per sub-station. The transformers of each station had likewise sufficient capacity to work on equivalent loading. Mr. Parker was definitely in favour of glass bulbs for trolley-bus working and mentioned that during eight years' service they had given no trouble and were still functioning satisfactorily. It was emphasised, however, that ample ventilation was necessary as the load which could be taken by the bulbs depended entirely upon proper cooling.

The trolley-buses themselves had been designed as three-axle vehicles, permitting 3½ tons total weight. The walls must be stronger than those of petrol buses. The propeller shaft ran at high speed and was driven by a motor having a rating of 80 h.p., and a maximum rating of 250 h.p. Electrical braking was obtained by means of a backward movement of the pedal in the driving cab, and slowed the bus down to a speed of 3½ miles per hour. A pneumatic brake was also provided and a hand brake was available, too. The air brake exhausted on to the resistances. Therefore, the more starting and stopping the bus was called upon to do, the more cooling effect was given by the air flowing from the brake exhaust. On the Crystal Palace hill, the most severe gradient on the trolley-bus system in London at the present time, a switch precluded the possibility of the bus reaching a speed of more than 2 m.p.h. If the driver was taken ill or the power was cut off, the buses would be likewise limited to a maximum speed of 2 m.p.h.

A battery was provided for lighting purposes, of 24 V in two halves. In series these gave a total of 48 V and were of sufficient capacity for driving the motor by means of the series winding and armature only, so that a bus might be driven from the battery (in the event of power supply failure) at 4 m.p.h. for a distance of one mile. This would bring the

Two views of the G.E.C. stand at the Ideal Home Exhibition (See page 491)

bus on to the next section, which would possibly be available to give power to the bus.

With regenerative control only a good driver could make it possible to save as much as 10 per cent. The arrangement was to supply regenerated current from one bus to another which happened to be in the same section. If, however, there was only one car in a two-mile section, the glass bulb rectifier, being a non-return valve, would naturally not take the returned current. It was therefore essential to have a surge resistance as a protection in each sub-station. Mr. Parker was of the opinion that it was much better to place these in the sub-stations than on each vehicle, which added weight and complicated matters.

A trolley-bus with contactors undoubtedly produced wireless disturbance. The method adopted by the Board to deal with this was to earth the overhead line through a condenser. In busy districts it was necessary to do this frequently, but on country roads it was permissible to do it, say, every half-mile only. Coils on the top of the buses added a top-heavy weight which was undesirable.

Supports for the Wires

By dropping the sag on the supporting wires, the weight on the poles had been reduced by half. For this purpose a rigid bar with two porcelain insulators had been introduced in the centre of the span actually to support the wires. Mr. Parker considered that porcelain was exceptionally good as an insulator and could be subjected to abuse without failing. There was no insulation between the two insulators, the bar being used as the distance piece. The earthing device previously mentioned was to be fitted on to this bar. This included two condensers with a fuse on each end which was then earthed on to the pole. The men on the inspection wagon could easily examine the fuses and the latest type had an observation window which indicated whether the fuse had blown.

Trolley shoe heads had in the past frequently pulled off. They must not be too tight, otherwise the overhead wire was liable to be pulled down. To overcome these difficulties, a special adjustable head had been adopted, which had a safety strip retaining the head, and was waisted to give a predetermined cross-sectional area, and consequent breaking value. The shoes would naturally wear and acquire a keen cutting edge. They must be examined frequently, otherwise they were liable to wear miles of overhead wire before the trouble had been discovered. A shoe could be worn out during the morning on a frosty day.

* * *

Power Station Development

In a recent lecture on this subject before the Derby Society of Engineers, Mr. F. Nicholls, borough electrical engineer, Derby, said that the rapidity with which development had taken place had sometimes caused alarm at the fact that the world was becoming mechanised. Each new application of science was a tool which had its day and was replaced continually by that which was better. Within the electricity supply industry itself the same radical changes were taking place. Mr. Nicholls described the low-pressure feed-water evaporator at the Derby Corporation power station, and also dealt with electrostatic precipitation. He said that in this country alone there was £350 millions of capital employed in the public electricity supply of cities, towns and villages. Even so we were only at the beginning of the uses of electricity.

Signalling in Mines

At a meeting of the Lothians Branch of the Association of Mining Electrical Engineers, Mr. J. A. B. Horsley, H.M. Electrical Inspector of Mines, read a paper on "Safe Signalling Bells and Telephones in Mines." The lecturer said that if justification was needed for bringing the subject before the Association it would be found in the circumstances of the explosion at Garswood Colliery, in November, 1932, in which twenty-seven lives were lost; and in that at West Cannock Colliery in May, 1933, in which six lives were lost. Both explosions were found to have been caused by sparking associated with the normal operation of a signalling bell not designed for use in the presence of fire damp. The paper was illustrated with lantern slides, and at the close of the lecture Mr. Horsley answered questions.

Crossed-phase Reactive Meters.

An accurate means of measurement

By G. W. Stubbings, B.Sc.

THE crossed-phase method of kVARh metering is so called because it utilises a standard three-phase meter by changing over the voltages applied to the two elements. The connections are shown in fig. 1, where the white-red voltage, which in an energy meter is applied to the red element, is here used to energise the blue element. The white-blue voltage is likewise crossed over. In order that the torque in each element shall tend to give forward rotation with lagging currents, the normal polarity of the voltage applied to the element carrying the red current is reversed. With balanced load and zero power factor the meter torque corresponds to twice the product of the line voltage and the line current in a balanced load, whereas the reactive VA is given by $\sqrt{3}$ times this product. The multiplying factor for a three-phase meter which is connected in this way is therefore $\sqrt{3}/2$.

A three-phase meter connected in this way will meter the kVARh in a balanced circuit, as the torque corresponds to the reactive VA in two of the phases, but the method is merely an approximate one, and is inaccurate with balanced loads. For, considering a single-phase, non-inductive load supplied from red and blue phases, the torque in the crossed-phase meter will be zero, but if this load is taken between red and

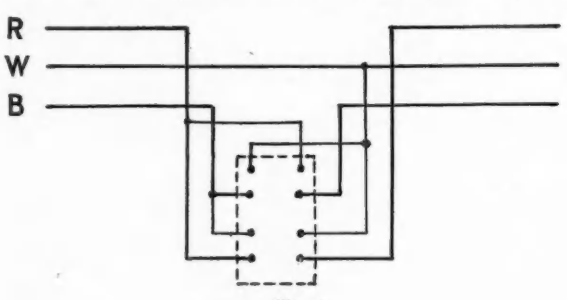


Fig. 1

white phases there will be a driving torque in the red element proportional to $\frac{1}{2}$IV.

If the accuracy of the crossed-phase method is compared with that of the other methods of measuring reactive kVARh by means of standard meters, it is found to be the least in error in all conditions of unbalance. The crossed-phase meter, with the correct constant applied to its registrations, gives $1\frac{1}{2}$ times the sum of the kVARh in two of the phases. A true reactive meter gives $1\frac{1}{2}$ times this sum, plus $\sqrt{3}/2$ times the difference of the watts in these phases. A three-phase meter with one element reversed, and with the correct constant, gives $1\frac{1}{2}$ times the sum of two of the phase kVAR, less $3\sqrt{3}/2$ times the difference of the watts. The errors of registration of all approximate methods of kVAR measurement are proportional to the difference of the watts in the two phases containing the meter elements, but the error is $2\sqrt{3}$ times this difference in the case of the meter with reversed element and $\frac{1}{2}\sqrt{3}$ with the crossed phase meter. The error of the latter meter is therefore always one quarter of that of the first. It can likewise be shown that the error of the crossed-phase meter is one half that of a single-phase meter energised by one line current and one line voltage.

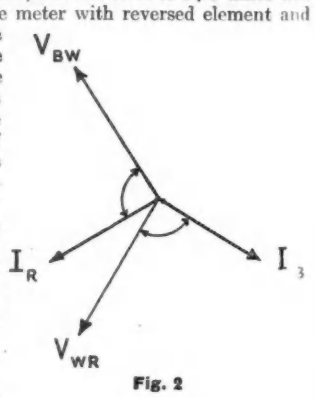


Fig. 2

A further advantage of the crossed-phase meter as compared with the reversed-element type is that for any reactive load the driving torque is twice as much, and inherent accuracy is therefore likely to be higher.

The great advantage of the approximate methods of reactive metering is that, as standard meters are used, no additional stock items have to be carried by the supply undertaking. The necessity for the application of a constant to the meter registrations could be obviated by the provision of a change wheel attachment to the clock registers of a certain number of the three-phase meters carried in stock. The multiplier of $\sqrt{3}/2$ for the crossed phase meter is given very approximately by the fraction 65/75. The changing over of the gearing ratio of a standard energy meter to make it a direct reading kVARh meter when connected according to the crossed-phase method would therefore be a very simple operation if the change wheel attachment were fitted to the meter register.

Correspondence

Contributions from readers are welcomed. The writer should give his name and address, not necessarily for publication

Earthing and Testing

Mr. G. E. Moore is right in saying that I was wrong in dubbing Wiring Rule 1002B, "impracticable." A slip of the pen: I should have said "unpractical." It is, of course, practicable to festoon any room with copper tape; but it is not practical, simply because, as I said in my article, no owner or architect would tolerate such disfigurement of a decent bathroom. Most of us would prefer the risks of the "lethal chamber" to which Mr. Moore alludes, since, after all, they are no more than those of any room above the ground floor. In any such room there is always the one chance in a billion that some extraordinary combination of circumstances may cause us to break our necks by falling out of the window.

I believe—I am guessing, subject to correction—that gravity claims as many victims in a week, though we never hear of them, as electricity in a year. But we don't insist on bars to every window, or make our frontages hideous with some system of catch-nets. We accept the toll of fatality as inevitable, without rushing into panic legislation—"Safety First!"—in an attempt to avoid it by a vain sacrifice of common sense, convenience and economy.

Again, I still maintain that the suggestion of putting the switch outside the bathroom is "fatuous." One might as well have the bath-plug controlled from outside. It must be a very small bathroom in which there isn't room for an all-insulated switch; and I would have it inside even if it must be within reach of the bath. If it is, the pendant itself is as likely to be; yet this is allowed although, despite Clause C, a holder may be potentially more dangerous than an insulated switch can ever be. Or perhaps, to be really on the safe side, we shall presently be told to put the light also outside the bathroom!

Of Mr. Moore's other point, defending the complicated exceptions to Rule 1001, I can only say that if a man is stupid enough to think of earthing the "metal work on electric clock cases of non-conducting material"—it sounds like "Beachcomber"—he's not likely to have the intelligence to make head or tail at all of the rule; and vice versa. That is the gist of my complaint of it, and of others in a less degree: that they are so involved in semi-legal jargon that the average wireman, for whom presumably they are mainly intended, cannot easily grasp what is of real importance in them.

Tatsfield, Surrey, *March 28th.* H. R. Taunton.

Abstruse Papers

I note that the Meter and Instrument Section of the I.E.E. is having a debate as to whether the Section is fulfilling its objects. There is a feeling that the papers in this Section are becoming too highbrow, and I sometimes wonder just how many members of all grades *do* really understand the mathematics in a great many of the papers included in the I.E.E. *Journal*—probably only a few designing engineers and degree men, while the rest of the Institution is looking on.

There is too much advanced theory and highbrow reading, which does not appeal to the average member of our Institution. How many full members (M.I.E.E.) of the old school are really at home with, and can wade through, these calculations? Lowbrow Graduate.

March 30th.

The Single-phasing Trouble

With reference to the article on this subject by Mr. M. V. Russell, which appeared in your issue of March 20th, I should like to draw your attention to the English Electric Co.'s burn-out protector which is eminently suitable for this type of protection.

If any three-phase motor, through any cause whatsoever, remains running on single-phase, then inherently with the same driven load the input current to the motor increases quite considerably and, therefore, the machine would heat up to an excessive temperature. The English Electric burn-out protector has been developed to safeguard the motor should such conditions arise.

The protector is fitted generally to the back of the stator core and is in intimate contact therewith. It is connected in series with the low-voltage coil of the motor starter, then if for any reason the temperature of the stator core has reached approximately 190 deg. F. (or over) and remains at this temperature for a period of about 15 minutes, the protector will operate and open the coil circuit, shutting down the motor.

This protector does not take the place of a quick-acting overload device, as the windings of a "stalled" motor may be burned out before the temperature of the iron has attained 190 deg. F., especially if the stalling occurs when the motor is started up from cold. The advantage of the protector is that it is fitted on the parts which are to be protected. In developing a device of this description it was appreciated that it should be simple, reliable and reasonably priced. L. Roberts,

Manager, Industrial Sales & Engineering Dept.,

Stafford, *March 28th.* English Electric Co., Ltd.

The thermal type of single-phasing preventor described in Mr. Russell's article appears to be the arrangement manufactured by this company, and in view of the fact that the casual reader might gather from the article that this thermal pattern is dependent upon temperature, we wish to point out that actually the device as manufactured embodies a compensating arrangement whereby it is independent of variations in room temperature. The Electrical Apparatus Co., Ltd.

London, S.W.8, *March 25th.*

Earthing for Heavy Currents

I would like to state my general agreement with the comments of "Toreador" in your issue of March 27th. In the course of experimental work in connection with earth-leakage protective apparatus, I have found the earth resistance to vary between 5 and 15,000 ohms when measured between a transformer earth plate and consumer's premises, this wide variation occurring in an area of a few square miles.

It cannot be assumed that 15,000 ohms is an extreme limit because when an earth plate is in contact with soil containing any chemical substance which can cause corrosion of the earth-plate surface a small leakage current can be rectified, and this rapidly builds up a very high resistance in its own path which prevents earth-leakage trip gear from functioning, even with a very high applied voltage. Since the soil circuit is so variable, the only certain guard against earth-leakage troubles is the provision of a continuous metallic path for leakage current. This need not be of low ohmic resistance because a tripping device can be employed with heavy-current switches.

For rural services supplied by overhead lines, it would be sufficient to insulate a single strand of a bare stranded conductor employed as the neutral, assuming the latter is earthed at the transformer. This insulated strand would not be subject to neutral-earth voltage fluctuation and would provide an adequate path for the leakage current required to energise the tripping device for the consumer's switch. The required 30-mA tripping current limit is unimportant; 500 mA at, say, 20 V would effect safety without undue sensitivity. In town areas where water service pipes are available, similar considerations apply. An earthing cable could be used in the circuit of a tripping device employed with main switches, although actually the water service pipe is suitable for most circuits protected by 5- to 10-A fuses.

Recently I have experimented with some 60-A switches having a quick-acting thermal release connected between the consumer's apparatus and a water-service pipe. The thermal device is designed to be inoperative in the event of an earth from a lighting or similar circuit protected by 5- to 10-A fuses, but to trip the switch in the event of an earth fault from apparatus such as a cooker which is now commonly protected by 30-A main fuses only. One practical difficulty has been that in out-of-town areas a dead-earth fault on a cooker may trip a circuit-breaker at a sub-station. If the cooker is connected to a water service, as is usual, the sub-station breaker setting must take into account the maximum current and its duration on the average water service.

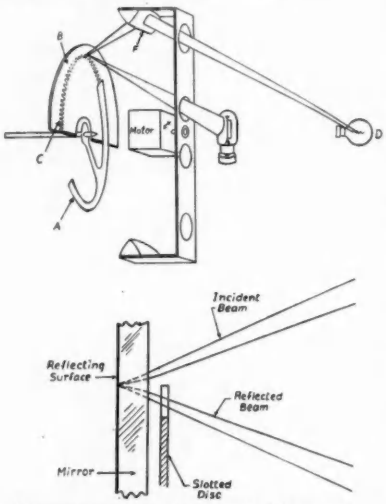
If the breaker is not provided with time lags then any cooker fault may open it and the faulty cooker may not be identified until this trouble has occurred a number of times. If time lags are fitted, then there is a risk of an earth fault causing a potential gradient on the water service pipe. The provision of a special earthing conductor of low resistance would not overcome the difficulties due to incorrect tripping or of identifying the faulty apparatus, and the solution appears to be to retain the water service pipe but to limit the possible fault current value to it.

So far, experiments indicate that the indirectly heated type of thermal trip is too slow for use with a consumer's main switch, so that either a directly heated thermostat having a suitable resistance and time lag, or a magnetic trip, is required. A standard type of earth-leakage trip switch for use in rural and town services will only be possible when the operating conditions can be stated. A. G. Bullen.

Liverpool, *March 27th.*

A Photo-telemetering System

TO facilitate control of the grid, a system has been recently installed in the control rooms of the Central Electricity Board at Glasgow and Manchester for providing automatically, at both points and for each individual meter, continuous records of generating station outputs and power flow between N.W. England and S. Scotland. An extension of its use to other control centres is in hand.



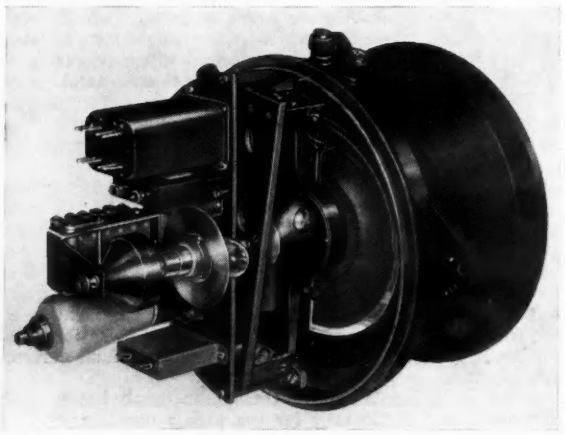
The arrangement of the photo-telemetering system

Readings of the sending instrument are converted to unidirectional pulsating currents, which are transferred into corresponding impulses of voice-frequency currents, suitable for transmission over commercial telephone channels. Each meter requires only a narrow band in the frequency spectrum, so that by means of selective circuits telephone communication and several telemeters can be operated over one pair of wires without mutual interference. At the receiving end the voice-frequency impulses are reconverted to unidirectional impulses, smoothed and passed into a moving-coil instrument scaled to correspond with the originating instrument.

Indications received are determined by the time characteristics at the magnitude, of the v.f. impulses; hence the readings are independent of such factors as the resistance and leakage of the telephone line and the gain of repeater stations, and a rise in the indication of the sending instrument increases the time ratio of the on periods to the off periods of the v.f. impulses. At the low speed employed (2.5 impulses per sec.) any distortion of the v.f. impulses in the line is generally insignificant.

In the transmitter, an opaque vane (A) attached to the rear end of the instrument spindle uncovers a semi-circular mirror (B) by amounts varying with the instrument reading. Two diametrically opposite lens prisms (F) are rotated about the axis of the instrument movement by a synchronous motor. Light from a lamp (D) focused by the lens prisms, falls alternately on to the vane, where it is absorbed and on to the mirror where it is reflected on to a photo-electric cell. Thus, the ratio of the length of the cell illumination period to the dark period varies with the instrument reading.

In one form of transmitter, an opaque slotted disc (C) is interposed between the mirror and vane, and the light is interrupted by each tooth of the disc as well as by the vane. The pitch of the teeth and speed of rotation are so arranged that the teeth interruptions take place at the requisite voice frequency, and the wave form needed is obtained by amplification, omitting the d.c. component.

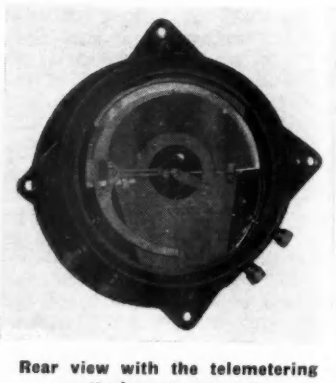


The mechanical portion of a transmitter comprising two main assemblies bolted together

Another form is without a slotted disc, the photo-cell current modulating the output of a valve oscillator, which oscillates at the requisite frequency; while the output wave form is the same in both types, with the second the generated frequency can more readily be kept within the close limits necessitated by the simultaneous use of one pair of wires for telephone communication and for the working of several meters. The triode oscillator impresses its output on the screen of a screened-grid valve so biased that normally there is little or no current in the anode circuit and the oscillations on the screen have no effect. The photo-cell is so coupled to the grid that illumination renders the grid potential less negative and permits anode current to flow. This current is modulated by the screened grid at voice frequency and the output of the valve is of the desired form. A 150-V neon tube stabilises the photo-cell potential, rendering the transmitter less dependent upon the constancy of the supply voltage.

Transmitted signals are ultimately received on a d.c. milliammeter, the current through which is dependent upon the ratio, and independent of the magnitude, of the v.f. impulses. These impulses are amplified by a valve sufficiently to strike a three-electrode neon tube. The third electrode is normally held at 30-V negative by the grid leak, but on striking a heavy positive potential is applied to it *via* the winding of the transformer and the combating gas. Coupled to the third electrode is the grid of a second valve, in the anode circuit of which is the receiving instrument and a controlled fixed resistor, which swamps the valve impedance and makes the anode current entirely independent of variations in the latter.

The output of the second valve is a string of constant amplitude impulses, and the quantity of current flowing in unit time is directly proportional to the time ratio of the impulses. A smoothing circuit enables the mean current to be read on an ordinary milliammeter. When the same pair of line wires is used for both telephony and telemetering, or when two or more telemeters are worked simultaneously, the telemeters operate at frequencies above the speech band, their impulses being kept out of the telephone instruments by low-pass filters.



Rear view with the telemetering attachment removed

At the transmitting end, a high-pass filter excludes from the line any extraneous low frequencies generated in the instruments. At the receiving end, the telemetering signals are amplified and then diverted to their appropriate instruments by filters. The system described has been developed by the Automatic Electric Co., Ltd., and is installed in association with A. T. M. Strowger supervisory remote-control apparatus. The measuring instrument for the transmitter was designed by the Metropolitan-Vickers Electrical Co., Ltd.

Electrical Exhibition at Gravesend

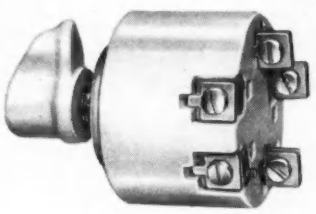
Electrical refrigerators were prominently featured at the annual exhibition of the Gravesend Electricity Department (engineer: Mr. C. F. McInnes), which opened on Monday last at Gravesend Town Hall, and continues until April 4th. The Mayor (Councillor G. R. Croft), opening the exhibition, said that during the last ten years the number of kWh sold by the undertaking had more than trebled, and the number of consumers had increased from 2,584 to 11,617. Demonstrations of electric cooking were given by Miss Weedon, of the Jackson Electric Stove Co., and Miss Montgomery, the Corporation demonstrator. The exhibition included Jackson cookers, Sadia water heaters, "Prestcold" and "Coldspot" refrigerators, and "Burco" wash boilers. The Gravesend branch of the Electrical Contractors' Association (Messrs. Allen & Son, Bailey & Son, Purcell & Son, and Harris & Son) had a large stand, attached to which was a display of smaller electrical components by W. T. Henley's Telegraph Works, Co., Ltd. A poster competition was held under the auspices of E.D.A.

New Apparatus and Devices

for Domestic, Cooking and Heating, Lighting, Power and Scientific Purposes

A Four-heat Cooker Switch

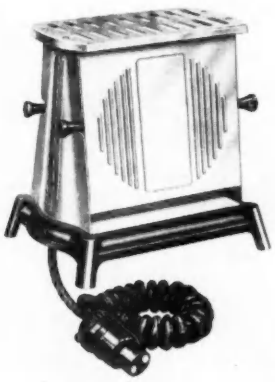
A special feature in the design of the new Arrow four-heat rotary switch is that the full 90 deg. separation is maintained in the break from "off" to "high" as with three-heat switches, thus avoiding flash-overs.



The Arrow four-heat cooker switch

In general, its appearance follows that of most of the rotary cooker control switches of Arrow Electric Switches, Ltd., Hanger Lane, London, W.5, the body handle being made of white porcelain. It is the same size as three-heat models and is interchangeable with them. The rating is 10 A at 250 V, and the switch is available wired for two different circuit combinations according to whether or not the fourth (simmering) heat is effected by a resistance.

An Electric Toaster



The "Ormond" toaster

The electric toaster introduced recently by the Ormond Engineering Co., Ltd., Ormond House, Rosebery Avenue, London, E.C., has a loading of 600 W, and is so arranged that by lowering the rack the toast is turned without being touched by hand. It is available with a nickel- or chromium-plate finish and is fitted with a dual adaptor for connection to a 5A socket or a lamp-holder. The element is wound in three forms suitable for 200/210, 220/230 and 240/250-V supplies.

Electro-medical Apparatus

Included in a range of new equipment introduced by the Medical Supply Association, Ltd., 167/173, Gray's Inn Road, London, W.1, are a new cold quartz lamp, the "Metro" vibrator and the "Provita Masseur."

The cold quartz lamp is used for attacking septic foci by the ultra-violet irradiation of local skin areas. The burners are transparent fused quartz "U" tubes (model A) or shaped as applicators closed at one end (model B); special shapes can also be supplied. Each burner has its own flexible connection which plugs into a socket in the control panel mounted within a compact carrying case.

The burner, which has a loading of 10 W, is self-starting

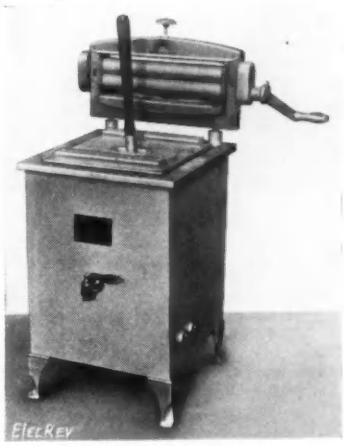
The M.S.A. cold quartz lamp

and remains cool in operation so that it can be used in contact with the skin or mucous membranes for long periods without discomfort. It is claimed that a first degree erythema can be produced on untanned skin after 1¼ minutes' contact. The emission is mainly in the short and bactericidal wave-lengths, about 87 per cent. of the output being present at 2,537 Au. New vibratory massage apparatus includes the "Metro" vibrator. The motor is mounted on a pedestal in a stirrup fitting enabling it to be set at any desired angle and locked by two wing nuts. All metal parts, other than the motor case and pedestal which is finished in white cellulose lacquer, are nickel plated, and a two-fold method of application is permitted with special rubber adaptors for local application and with a massage belt.

The "Provita Masseur" is specially designed for trunk massage, the movement being transmitted from the motor to the patient by means of a wide canvas belt through a reduction gear to prevent overloading of the motor. The adjustment provided enables any degree of intensity to be obtained from a very light vibration for surface work to a very deep and penetrating massage for abdominal treatment. The motor is fixed to a pedestal support, thus making the complete unit easily transportable from room to room.

A Small Clothes Washing Appliance

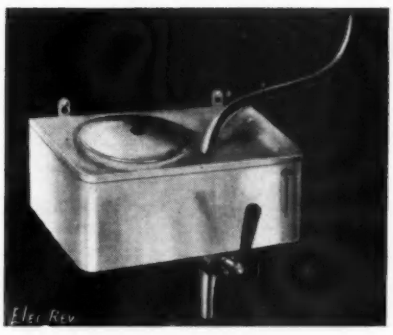
The "Uno" midget washer, which is manufactured by the Universal Boilers and Engineering Co., Ltd., Oxford Mill, Burnley, comprises a square electric wash-boiler with an aluminium agitator and wringer, both hand operated. No heat insulation is provided other than the air space between the sheet-steel casing and the pan, which is made of copper tinned on the inside. When not in use the machine can serve as a table, a white vitreous enamel top being fitted.



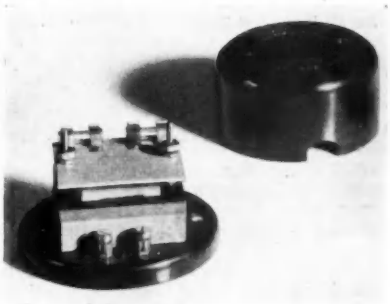
The "Uno" midget washer

A High-speed Auxiliary Boiler

A neat "booster" has been introduced by Messrs. Berry's Electric, Ltd., 85/86, Newman Street, Oxford Street, London, W.1, for fitting to the "swan neck" outlet of a ½- or 3-gal. water heater. Water is passed to the "Auto-boiler" by turning the tap of the water heater, and boiling point is reached within two minutes. A float in the "Auto-boiler" operates a mercury switch, bringing a 1-kW element into circuit; if, however, only warm water is required, the tap on the "Auto-boiler" is left open and the water flows straight through from the water heater. The "booster" is fitted with a lid.



The "Quick-Safe Auto-boiler"



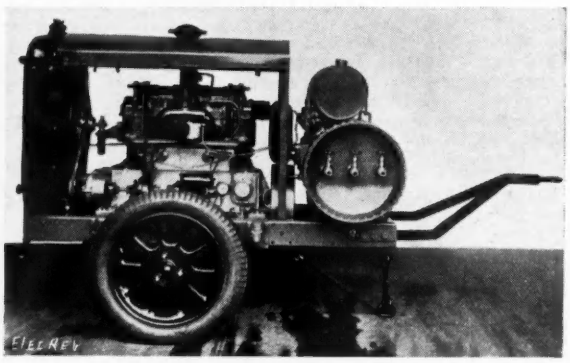
This fused bell transformer in a circular bakelite case is a recent product of Messrs. Henry Peace, Ltd., Wednesbury. It gives an output of 3, 5 or 8 V from a 200/230 V supply

Emergency Lighting Equipment

The "Ray" emergency lighting equipment, a new development by the Ray Engineering Co., Ltd., 53, Queen Square, Bristol, 1, comprises a control rectifier and battery and is made up in several sizes to meet individual requirements. The control rectifier is housed in a cast-aluminium and sheet-steel case with crystalline finish and matt black panels, the 200/240-V heavy-duty transformer being double wound and air-cooled. The accumulator is made by the Alton Battery Co., Ltd.

A Portable Air Compressor

The portable air compressor known as the "Supalight" has been specially designed by Messrs. Broom & Wade, Ltd., High Wycombe, to give a relatively high output for its weight. The complete outfit mounted on a carriage with two pneumatic tyred wheels weighs 14 cwt., while with a displacement capacity of 82 cu. ft. per minute it actually delivers



The "Supalight" portable air compressor

60 cu. ft. of free air per minute at 100 lb. pressure. The petrol engine and air compressor are combined in a single cylinder block with four cylinders. There is a quickly adjustable front support for stabilising the plant while in operation. A mounting is provided to carry a concrete breaker or other tools. It is capable of operating one heavy-duty concrete breaker, two spades or two backfill rammers, and is suitable for general mains laying and service duties.

An All-insulated Inspection Lamp

For some years the Wenham Lighting Corporation, Ltd., 304, Henry Street, Gray's Inn Road, W.C.1, has marketed a hand inspection lamp, known as the "Ace," fitted with a tough rubber handle. This can now be supplied with an all-insulated guard made of one-piece fibre with a rubber channel ring at the base for mechanical protection, the only metal parts used in its construction being the liner and buffers of the lampholder. The interior is enamelled white, and the lampholder is provided with a bakelite H.O. skirt. The price is the same as that of the older model, which, incidentally, is still obtainable.

An all-insulated inspection lamp

Coloured Switches and Switchplugs

We are informed by Messrs. J. H. Tucker & Co., Ltd., King's Road, Tyseley, Birmingham, that their range of "New Titan" switches and switch-plugs is available in colour, including surface and semi-recessed small base switches, flush switches, and two and three-pin top entry surface switch sockets; the flush switch sockets will be obtainable shortly.

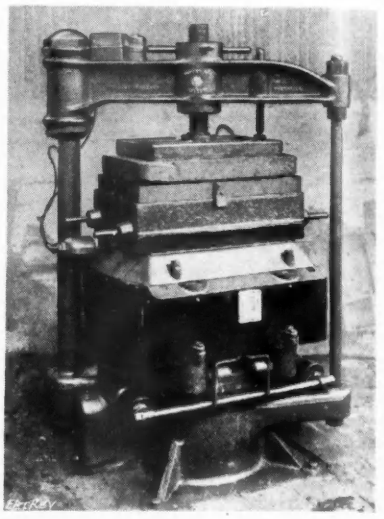
Several unusual features are incorporated, such as a metal reinforcement in the dolly which is entirely isolated from all live metal parts, and a "tripping" arrangement in the base to return the mechanism to the "off" position should the switch be mishandled. The plates of the flush patterns give an extra wide overlap of a quarter of an inch beyond the box on each side. The plugs incorporated in the switch-plug combinations are the four-entry tunnel type with easily removable knock-outs, providing entries for all sizes of cable up to 16/.012 gauge. In addition to the usual brown, walnut and white finishes, mottled green, blue, orange and ivory are now produced.

Moulded Bakelite Shades

Bakelite translucent lampshades suitable for use with all standard b.c. lampholders are being made by Messrs. Ward & Goldstone, Ltd., Frederick Road, Pendleton, Manchester 6. They are light and resilient, and so are particularly suitable for export. They are supplied in square, round and octagonal shapes in alabaster or pearl finish.

Magnetic Moulding Machines

A range of magnetic moulding machines has been developed by British Insulated Cables, Ltd., Prescot, Lancs., for the rapid production of light castings on a repetition basis. Each moulder is a self-contained unit, and so involves no maintenance of hydraulic or air pipe-lines and pumps, while no expensive foundations are needed. The power for the squeeze operation is obtained by direct electrical means through a solenoid or solenoids mounted in the base of the machine.



The B.I. magnetic moulding machine engaged in the production of suspension fittings for electric traction. The mould is shown ready for squeezing

Where a.c. only is available, a comparatively small rotary convertor can be used to supply the d.c. required. In such circumstances the control circuit is so arranged that only one convertor is required for a battery of machines, a sequence relay preventing two machines from drawing current at the same time.

Power is used only during the squeeze stroke, which lasts for about two seconds; a battery of machines can therefore be operated without appreciable idle time, which aids in economic production.

A Smaller G.E.C. Vacuum Cleaner

The new D.M.180 vacuum cleaner made by the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, although of similar general design to the present *de luxe* model, is cheaper, lighter and smaller, being designed specially for small houses and flats.

The nozzle is 11 in. long, and is surrounded by a rubber buffer to prevent damage to furniture; it is adjustable by means of a lever for various carpet thicknesses. The motor, which has a twenty-six segment commutator, is rated at ⅛ h.p. and runs at 10,500 r.p.m., driving a revolving brush at 3,500 r.p.m. This gives an air velocity of 223 ft. per sec. and a water gauge measurement of 11 in.

The control of the motor is by a switch situated in the handle, and, unlike the *de luxe* model, movement of the handle to a vertical position does not automatically switch off the motor.

The new "Magnet" cleaner

Starter Circuit-breakers

For direct-on-line starting of a.c. motors Messrs. Mickelwright, Ltd., Alperton, Wembley, Middlesex, have introduced a new starter circuit-breaker. It is of the triple-pole contactor type with a thermal tripping device in each phase, being primarily intended for use with three-phase induction motors to provide simple push-button control and give full protection to the windings of the motor in the event of sustained overloads or faults in the motor itself. It can, however, be used on single-phase and two-phase three-wire systems by slightly modifying the wiring.

The construction of the breaker is such that it allows heavy overloads to be carried for short periods, but automatically breaks the circuit before the overload is able to cause any undue heating in the motor windings. An instantaneous tripping device is also incorporated. This comes into action at approximately nine times the current rating of the starter and eliminates any possibility of damage to the thermal delay device. A no-volt release that operates at 35 per cent. of the normal voltage is also incorporated. The starter is mounted on a "Sindanyo" base, and has a double-break contactor which is fitted with self-aligning silver-tipped contacts of the pressure type.

B.E.A.M.A. and Tariff Questions

IN reviewing the 1935 report of the British Electrical and Allied Manufacturers' Association in our last issue we made brief reference to the work of the Association's Tariff Committees, a matter which deserves a more detailed treatment. It is stated that during the year the importation of electrical accessories increased, reinforcing the B.E.A.M.A. case for higher duties on those goods. The questions of definition and of Customs identification of the various types of accessories covered by the Association's application were settled and the matter is now under consideration. The Tariff Committee (Home) is at present engaged in preparing applications for increased duties on other classes of electrical goods which are being imported in increased quantities.

Japanese competition in accessories and smaller apparatus showed signs of increasing intensity, and several instances of "dumping" and of the dangerous nature of certain cheap accessories were brought to the notice of the Import Duties Advisory Committee. The need for increased protection against the heavy and continued importation of house-service meters was also impressed upon that Committee. The Association successfully opposed the lowering of Customs duties on certain component parts of primary batteries.

Evidence was presented to the Board of Trade Committee which was set up to consider the position which will arise upon the expiry next August of the duties imposed under the Safeguarding of Industries Act, 1931 (Key Industry Duties). The electrical goods affected are radio valves, mercury-vapour rectifiers (glass-bulb type), scientific instruments, arc lamp carbons, and amorphous carbon electrodes. A temporary exemption from the 33⅓ per cent. duty, to expire on December 31st, 1935, had been granted in respect of mercury-vapour rectifiers of certain types. The views of interested members were put before the Board of Trade and as a result the exemption was not renewed; in consequence all types of glass-bulb mercury rectifiers are now subject to 33⅓ per cent. duty.

A comprehensive report emphasising the need for the continuance of the duty was submitted to the Key Industries Committee and oral evidence was given by Mr. L. W. Smith, a member of the Council, and Mr. C. Rodgers, deputy director and secretary of the Association. It is expected that such recommendations of the Committee as may be adopted will be embodied in the Finance Bill for 1936.

The Association was appointed as the scrutinising body for applications made to the Import Duties Advisory Committee for licences to import, free of duty, special electrical machinery not procurable in the United Kingdom. This arrangement has been in operation for a number of years and continues to work satisfactorily. The Association has been able, in several instances, to satisfy the Committee that suitable machinery was procurable in this country, thereby avoiding the need for duty-free admission of foreign-made machinery. There has been a gratifying reduction in the number of inquiries referred to the Association.

During the course of the session the increasing number of inter-nation trade agreements, import restrictions, and alterations in overseas tariffs were the principal subjects engaging the attention of the Tariff Committee (Export). With regard to Australia the Committee says that so far as electrical goods are concerned the Ottawa Agreement has not secured to British manufacturers all the advantages which were anticipated. The outcome of the Committee's representations on the existing high level of Australian duties on certain British electrical manufactures has so far been discouraging. The Committee had under consideration a number of applications to the Australian Tariff Board for increases in duties on electrical apparatus.

The services of the Australian Association of British Manufacturers have been utilised in representations to the Board on behalf of several sections of the industry. In the case of a proposed application of anti-dumping duties to house-service meters of United Kingdom origin, this joint effort was successful and the application was dropped. In the recent Australian Budget proposals were adopted for the insertion in the Australian tariff schedule of an "intermediate" rate of duty to be applied to any specified goods the produce of any specified British or foreign country. The position is being closely watched by the Committee.

The Committee considered that the time was inopportune for proceeding with the suggested representations to the Canadian Tariff Board, the results so far achieved by other industries being discouraging. The position arising from the arbitrary valuation by the Canadian Customs of United Kingdom goods for duty purposes has been satisfactorily cleared up, it being established that the power to make such valuations and impose such duties was abrogated by the Ottawa Agreements.

The trade agreement between Canada and the United States came into effect on January 1st, 1936. Under this agreement, Canadian duties on a number of electrical items were reduced. On three items the margin of preference afforded United Kingdom manufacturers, as compared with the intermediate tariff, has been reduced. The Ottawa Agreements expire in November, 1937, and the situation that will then arise is under consideration by the Committee.

The arrangement whereby the Association administers the quotas granted to United Kingdom manufacturers for certain electrical apparatus imported by France continued to work satisfactorily. During the past session another important class of electrical equipment was added, making nine classes for which the necessary import certificates are now obtainable from the Association, and an increase in the number of certificates issued is recorded.

Following on the ratification of the Anglo-Polish Trade Agreement negotiations with the Polish electrical authorities have continued. The Association was successful in securing additions to the schedule of electrical goods for special consideration on importation into Poland from the United Kingdom.

The trade agreement between the United Kingdom and South Africa was signed on August 30th, 1935. The agreement embodies the reciprocal grant of most-favoured-nation treatment between the two countries, and covers all classes of goods which were not specially provided for in the Ottawa Agreements.

Registered Electrical Contractors

THE annual meeting of the National Register of Electrical Installation Contractors is being held this afternoon (Friday). The report of the Executive Committee for 1935, which is to be presented at the meeting, shows that during the year 219 applications for registration were received, of which 75 were accepted, 66 were declined, 18 were withdrawn, and 60 were still under investigation. The number on the register at March 6th last was 1,740. The net increase during 1935 was only nine.

This smaller rise in the total is attributed to the smaller number of applications received and the proportionately high number declined as a result of inspection of the applicants' work prior to registration. During the year six contractors were removed from the Register for bad workmanship, thirty-nine failed to renew their registration, and one was removed for breach of rules. Financial failures accounted for the disappearance of twelve contractors.

Special mention is made of the activities of the Scottish Committee under the chairmanship of Mr. J. W. Cooper, which have resulted in further applications for registration from Scottish contractors and caused more interest to be taken in the Register in Scotland. Reference is also made to a joint conference of the Register and the Electrical Contractors' Association with the object of securing closer co-operation between the two organisations. A sub-committee appointed to deal with the matter is to report to the main conference. The question of revising the rules and conditions has been deferred pending the issue of this sub-committee's report.

Embodied in the Executive Committee's report is the report on inspection work carried out during the year by the Register's inspectors. It is stated that by interviews with applicants for registration evidence is elicited of their fitness. One test is their knowledge of, and willingness to comply with, the I.E.E. Regulations. The inspection of applicants' work has resulted in the rejection of about 38 per cent.

As regards the testing of the work of contractors who are already on the Register, an analysis of 1,056 reports showed that only eighty-six were using continuity testers, 467 used a bell and battery only, while 165 made no test at all. Those using unsatisfactory testing methods have been warned.

The principal faults disclosed by inspection are:—Single-pole switches on the earthed or neutral pole; broken continuity or high resistance of conduits or cable sheathing; unearthed metal-covered switches over conductive floors and in proximity to earthed metal; the use of two-pin plugs and sockets for portable apparatus in proximity to earthed metal; the use of unearthed three-pin plugs and sockets; omission to bush tube ends; unearthed main ironclad switches; overcrowding cables in conduit; the use of earthing leads smaller than those specified by the I.E.E. Regulations and improperly attached; un-

protected cable in roof and floor spaces; failure to bring the protective covering of cable through to the surface of walls and ceilings; and carelessly run t.r.s. cable.

Where faults have been discovered the contractor concerned has been warned or asked for an explanation. As a result of inspection ten contractors (the main report says six) were removed from the Register during the year. A second or third inspection showed that a majority of those visited had improved their work, and the visits have had the effect of persuading contractors to acquire continuity testers. The educational value of the inspection system is given particular stress.

Altogether 499 inspections were made during the year, including the work of 203 new applicants. A summary shows that subsequently 237 letters were sent to contractors. In 131 cases explanations were accepted and undertakings were given to improve work; in twenty-two cases repeat inspections were ordered; while sixteen contractors (another apparent discrepancy) were struck off the Register. Since inspection commenced 1,093 inspections have been made, of which 353 were of the work of applicants for registration.

Parliamentary News (BY OUR SPECIAL REPORTER)

BILLS promoted by the London Passenger Transport Board, the Great Western Railway Co. and the London and North Eastern Railway Co., which taken together give the necessary Parliamentary authority for the scheme of transport improvement to be undertaken with Treasury guaranteed capital, were considered on March 24th by a Select Committee of the House of Commons. Sir Henry Cautley presided. Many petitions have been lodged against the Bill by local authorities and property owners.

Mr. Tyldesley Jones, K.C., for the promoters, said the scheme included the construction of 12 miles of new tube railways, and the electrification of 44 miles of suburban lines. The Transport Board already had power to work trolley buses over 148 route miles. It now asked for power to convert another 52½ miles of tramways to trolley vehicle working. In that connection there were petitions dealing with the provision of turning places, and the committee would also have to consider in due course a point about the rating of trolley vehicles. The main tube and railway electrification works were outlined when the Chancellor of the Exchequer made his announcement last year, and it had now been decided that in addition to electrification at Liverpool Street and King's Cross Stations the line between Stratford and Fenchurch Street should also be electrified. Originally it was estimated that the cost of the schemes would be £35,000,000, but the total was now likely to be about £42,000,000.

On March 25th evidence was given by Mr. Frank Pick, vice-chairman of the Board, who said it was proposed to spend £2,500,000 on putting the power houses at Lots Road and Greenwich on a more satisfactory basis. They could produce electricity at a lower cost than that charged by the Central Electricity Board.

At the Greenwich station, which would supply energy for trolley buses, five of the seven units would be replaced. When the programme authorised by the Bill was in operation they would be buying more than half their electrical energy from the grid; they did not intend to build new generating stations.

On March 26th Mr. Pick, answering Sir Arnold Gridley, a member of the Committee, said that the matter of the standardisation of sub-stations to meet the different frequencies employed was being discussed with the Ministry of Transport and the Electricity Commissioners.

On March 27th the Committee gave approval to the railway part of the London Transport Board's expansion programme, and then proceeded to hear the case for an extension of the railless trolley routes operated by the Board.

Mr. Tyldesley Jones, K.C., said that the Board now had power to convert 166½ miles of the tramway system to trolley vehicle working, and asked for power to convert another 52½ miles. The new routes included lines from Harlesden through Shepherd's Bush, Hammersmith, and Putney to Wandsworth, Tooting, Mitcham and Croydon; from Holloway to King's Cross; from Barnet to Kentish Town *via* Highgate; and from Waltham Cross *via* Tottenham to Stamford Hill. The Board was now operating trolley vehicles on 59 miles of route, and they were so successful that no one opposed their extension.

A question had been raised by the Ministry of Health on a clause in the Bill dealing with rating. The present position was that tramways were rated on the full assessment, but that light railways in respect of certain rates were only assessed on a quarter. As some of the lines which it was now proposed to work by trolley vehicles were authorised as light railways the Board asked for that exemption to be continued.

Mr. Jones agreed that the Board would get rid of the liability to repair the roadway, but said that they were hit very heavily by increased taxation. Instead of paying 15s. per vehicle they would have to pay £96.

The Chairman said that he disliked people being let off rates, and the point was still under discussion when the Committee adjourned.

The North Wales Electric Power Bill

This Bill which was first on the list of a group of Bills fixed for consideration by a Select Committee of the House of Commons on March 24th, has been withdrawn from that committee and sent to the Committee on Unopposed Bills. By this measure the North Wales Electric Power Co. seeks authority to increase its capital from £1,000,000 to £3,000,000 and to amend Section 43 of the Company's Act of 1904 which prescribes the dividends payable in relation to the prices charged to consumers.

Petitions against the Bill were lodged by the Denbigh, Salop, Flint and Caernarvon County Councils, the Wrexham and Oswestry Corporations, and the Hawarden Rural District Council. In their petition against the Bill the three last-named local authorities expressed the belief that the reason for the proposed amendment of the said Section 43 was the altered circumstances brought about by the constitution of the Central Electricity Board and establishment of the grid system. Under the clause the company could bring into account the supply to the Central Electricity Board and after the re-sale back to the company the supply to a subsidiary company of its own, and the average price would thereby be greatly influenced and the consumers throughout the area of supply would be prejudiced.

The promoters have now agreed to insert in the Bill an addition to Clause 3 providing that " in calculating the average price per unit obtained by the company for the energy supplied by them no account shall be taken of any energy supplied by the company in bulk to the Central Electricity Board or their successors, or energy supplied by the company for consumption outside the area of supply." All petitions against the Bill have now been withdrawn, but the two Corporations and the Rural District Council reserve the right if they think fit to oppose the Bill when it reaches the House of Lords.

Yorkshire Electric Power Bill

This Bill was considered on March 25th by the Select Committee of the House of Lords on Unopposed Bills. This measure increases the powers of the company in respect of investment in companies to which it is giving a bulk supply, and further provision is made with regard to the appointment of managing directors. Formal evidence having been given in proof of the preamble, the Bill was ordered to be reported for third reading.

The Electricity Supply (Meters) Bill

On March 24th, in the House of Lords, Lord Eltisley moved the second reading of the Electricity Supply (Meters) Bill. He recalled the fact that by the Electric Lighting (Clauses) Act, 1899, provision was made for the appointment of " electric inspectors " to certify the accuracy of meters and to approve their pattern, type and construction. These inspectors were to be appointed by the municipal authorities in areas where the supply of electricity was given by a company, and by the Board of Trade where the municipal authority was supplying electricity. For some reason, no inspectors were ever appointed except in London and a few centres.

The position now was that millions of electricity meters had been installed which, although of approved type, were nevertheless not individually certified as appropriate for the measurement of supplies of electricity. As to the meters already installed, there were no reasonable grounds for believing that they were in any way unsuitable for their work. Practically no meters had been installed for years past or put into service unless they were designed and manufactured in accordance with the specifications laid down and approved by the Electricity Commission, and were proved to be accurate.

Millions of consumers of electricity were affected by the Bill. There were said to be over 7,000,000 users of electricity, many of whom had two or more meters installed. Only this year the Electrical Development Association had set out to gather in 1,000,000 new consumers. Its campaign had met with remarkable success, and there was every probability that this large figure would be reached. All these meters would have to be individually certified after a test, or they would have to be replaced by certified new meters.

Little imagination was required to see what a great expense would be involved. It was said that it would cost anything from 10s. to £1 to take out, test and replace a meter, or return the old meter after certification. If that be the kind of figure, a charge of some £5,000,000 or £6,000,000 would have to be incurred to carry out to the full the provisions contained in the Act of 1899. Moreover, it was very doubtful indeed that sufficient technical personnel would be available to carry out those tests in a reasonable time and in a satisfactory manner. If the expense of this great certification of meters were incurred, it put even further off the likelihood of reduction in the cost of electricity to the consumer.

A recent judgment established that, technically speaking, the great majority of the meters now in use had not been officially certified and, as a result, were not legal instruments with which to register or to measure electricity. This judgment obviously created a difficult situation for the electrical supply industry. Any cantankerous individual was entitled to challenge his account for electricity on the ground

Business and Industrial Notes

The Week's News. Showrooms and Exhibitions. New Installations. Overseas Trade. Publicity Material. Trade Announcements. Prices of Materials. Liquidations and Bankruptcies.

Propaganda at Hackney

A big effort to increase the use of domestic electrical appliances is being made at Hackney, where an exhibition and demonstrations which will continue for a month started this week at the municipal showrooms. Route signs have been fixed to a number of street standards, and outside the showrooms there is a large display board with the words "Come Inside Now." Acting on the advice of the borough electrical engineer, Mr. E. A. Mills, the Council has approved new tariffs which will benefit the consumers by £28,500 in a full year, and it is setting an example in the "all-electric" idea by providing complete electrical installations in its own houses. Last Saturday the Mayor (Ald. H. E. Goodrich) declared open a new demonstration hall at the showrooms as well as additional office, workshop and stores accommodation. The chairman of the Electricity Committee (Coun. E. Du Vergier) outlined the progress that has been made since the undertaking was purchased by the Council nearly forty years ago. After the official ceremony parties were conducted over the showrooms and the power station, where a second 30,000-kW turbo-generator is to be installed, and they were later entertained to tea.

The new demonstration hall at the Hackney showrooms

Stimulating Electrical Appliance Sales

An enterprising method of promoting the sales of domestic electrical appliances is reported in the *Electrical World*. Under a plan developed by the Coast Counties Gas and Electric Company, Santa Cruz, California, all domestic consumers were presented with gift certificates amounting to 50 per cent. of their month's electricity accounts. These certificates could be cashed by the consumers at any electrical dealers' stores at their full face value as payment for electrical appliances, the company refunding the dealers the value of the certificates, less 10 per cent. The offer remained open for one month only.

Sydney Contemplates Large Extensions

We are advised by Messrs. Preece, Cardew & Rider, consulting engineers to the Sydney County Council, which now controls the Bunnerong Power Station, that the Council is contemplating the extension of the existing plant of the electricity undertaking by two 50,000-kW turbo-alternator sets and four boilers, each of 350,000 lb. per hour evaporation, steam pressure about 650 lb. per sq. in. at 850 deg. F. It is anticipated that the specifications will be available about the middle of April. The first unit is required to be in operation by February, 1939, and the second unit by February, 1940.

Economic Conditions in Finland

In a report on economic conditions of Finland, by Mr. K. Jopson (Commercial Secretary to H.M. Legation at Helsingfors) (Stationery Office, 1s. 3d. net), it is stated that the imports of electrical machinery for the first ten months of 1935 totalled 1,386 metric tons (against 1,220 metric tons for the whole of 1934). Accumulators and parts totalled 389 metric tons (against 496 in 1934), incandescent lamps 27 metric tons (against 56 metric tons), and insulated cables, &c., 1,293 metric tons (against 896 metric tons). While there was a considerable increase in the purchase of general machinery from the United Kingdom during 1935, this country was not so successful in electrical machinery, though the prices appeared to be nearer those of Continental and Swedish competitors. The sales of such equipment as electric motors, generators and transformers amounted to 2.9 million Fmks. for the first ten months of 1935, against 2.8 million Fmks. for the whole of 1934. While trade in accumulators was declining, the United Kingdom ranked ahead of Germany as principal supplier. Sales of lead-covered cables and wireless parts and components improved considerably.

Our Classified Advertisements

Our Advertisement Department asks us to state that owing to the Easter holidays classified advertisements for our April 10th issue must reach these offices by 5.30 p.m. on Monday next.

Names Wanted

The International Refrigerator Co., Ltd., recently sent particulars of its 1936 developments to electrical traders all over the country and enclosed reply-paid postcards by means of which further details could be obtained. Many of these cards have been returned with a signature only, and the company is anxious to have the full names and addresses of these inquirers to enable it to reply to them.

The B.B.C. Belfast Studios

Renovation work recently completed on some of the B.B.C. studios at Belfast has been carried out by Messrs. G.

Parliamentary News (*Continued from preceding page*)

that it had not been metered through an appropriate certified meter, and the Courts must in law find in his favour, although for some mysterious reason this would not relieve the consumer of the obligation to pay an appropriate sum for the electricity which he had in fact consumed. The Bill was introduced to ensure that all meters should in future be officially certified, and it also was an attempt to obviate the huge expense of official certification of all meters which were at present in use.

All the associations of supply undertakings, both municipal and company, had agreed that the best method would be to extend the work of certification to officers appointed by the Electricity Commission. At the same time, the Bill set up an effective body of persons to whom any consumer having a grievance or believing he had a grievance could appeal for a test of his meter, if he was not satisfied by the tests now being carried out by the undertakers. If the Bill were approved both consumers and supply authorities would be placed in a more satisfactory position.

Lord Roche had pointed out that, as it stood, Clause 2 might have the effect of altering a decision already given by the Courts. He had indicated a method by which the clause might be amended, so as to secure the reasonable objects of the Bill without being open to this objection. He (Lord Eltisley) proposed to submit the terms of the amendment, after consultation with Lord Roche, to the House on the Committee stage.

Lord Gainford supported the Bill, but said that one or two amendments would be proposed in the interests of consumers. Lord Roche explained his objection to the Bill but said that if, as he understood, Lord Eltisley gave an assurance that the necessary amendment would be made, he had no objection to the second reading. Lord Onslow, the Chairman of Committees, said that he hoped the Bill would be passed.

Lord Plymouth, on behalf of the Government, gave general support to the Bill and it was read a second time.

Inverness Water Power

On March 26th Mr. Hardie asked the Secretary of State for Scotland whether his Department was prepared to consider using the water power in Inverness for the purpose of providing power for the production of materials essential to industry in this country.

Colonel Colville, who replied, said that the Secretary of State did not consider that it would be competent for his Department to undertake the construction of hydro-electric works, but all aspects of the economic development of the Highlands would continue to receive his attention.

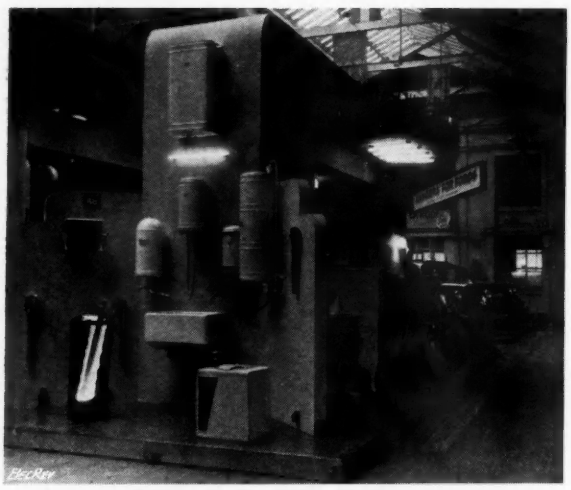
McCartney & Co., Belfast, who used Henley cables exclusively. Studios No. 1, 2 and 3 have been brought up to date with new signal lighting, telephones, buzzer and microphone circuits, and special listening rooms have been provided in each studio. Two new studios have been installed—No. 4 for talks and No. 5 for gramophone reproduction. The storage batteries for the new studios were supplied by the Hart Accumulator Co., Ltd.

Calendar

"Cynthia," the subject of the 1936-37 calendar received from the Metropolitan-Vickers Electrical Co., Ltd., is an attractive example of fair English beauty and maintains the high standard of the company's series of "girl" calendars.

The National Trades Exhibition, Birmingham

The accompanying illustration shows a section of the stand of the Birmingham Corporation Electric Supply Department



The water heater display on the Birmingham Electric Supply Department's stand at the National Trades Exhibition

at the National Trades and Industrial Exhibition, which was held last month at Bingley Hall, Birmingham. The stand had a comprehensive display of labour-saving appliances, including electric cookers, fires, water heaters, wash boilers, washing machines, and refrigerators.

New Met-Vick Staff Dining Room

The Metropolitan-Vickers Electrical Co., Ltd., has recently opened a large addition to its dining room accommodation at Trafford Park, Manchester. The new building, which is a staff dining room for men, has an area of 150 ft. by 90 ft., and provides seating accommodation for over 1,100 diners. It has been built by the company's own Building and Maintenance Department, and includes an all-electric kitchen with the latest type of equipment and labour saving devices of all kinds, notably electric ovens, grills, fish fryers, refrigerators, and washing, drying, cleaning and polishing machines. This is only part of the company's dining room service; other rooms are provided for the management, women staff and workmen and work girls from the factory. Altogether there is seating accommodation for about 4,500 people. The whole service is organised and supervised by the company's staff.

Old Cromptonians' Dinner

The annual dinner of the Association of "Old Cromptonians" will be held on May 22nd, at the Hotel Victoria, Northumberland Avenue, W.C.2. Tickets for the dinner are obtainable from the hon. secretary of the Association, at Bush House, W.C.2.

Cable and Overhead Line Costs

At a recent meeting of the Lancaster Corporation, when tenders for rural extensions were under consideration, the engineer reported that the cost of standard .15 sq. in. four-core distributor cable had gone up by over 61 per cent., and that although the work actually in hand at the moment would be completed with underground cable it appeared likely that future work of this kind would have to be carried out by overhead lines unless a very substantial change took place during the next few months in the prices of cables.

Pensions at Sixty

Messrs. David Brown & Sons (Hudd.), Ltd., have introduced a contributory scheme for their male weekly and monthly rated employés over twenty-one years of age who have completed three months service. Under the scheme employés will receive a pension on reaching the age of sixty, whether they retire or not, in respect of each completed year of service after the age of twenty-one up to a maximum of ten years. In addition to paying the balance of the cost of every employé's contribution, the company bears the whole cost of past service pensions, and also the whole cost of the cover for the insurance of all pension scheme contributors.

Irish Free State Electrical Imports

So far this year there has been a steady tone in the electrical trade in the Irish Free State. The imports of electrical machinery and allied material during the two months ended with February last attained a value of £149,213, an advance of £4,952 over the corresponding period of 1935. The details of the imports are given in the appended table:

	1934. £	1935. £
Electric motors	5,122	10,091
Other electrical machinery	40,193	26,089
Dry batteries and parts	3,681	2,011
Electric lamp bulbs	10,160	9,769
Elec. lighting accessories, fittings and parts	10,638	18,484
Electric wires and cables, insulated ...	12,327	12,735
Teleg. and teleph. apparatus	899	1,706
Radio receivers, apparatus and parts .	28,373	21,474
Other electrical goods and apparatus...	32,868	46,854
Totals	£144,261	£149,213

As will be seen, the imports of motors and machinery show a slight falling-off, this, however, being more than counterbalanced by the advance in several of the other items.

Trade Announcements

Messrs. Leonard J. Beard, electrical engineers and contractors, 33, Liverpool Road, Leyton, E.10, have moved their head offices to 524, High Road, Leytonstone, E.11. The telephone number is unchanged, and a night service has been inaugurated (telephone, Leytonstone 1203). The Liverpool Road offices are retained.

Messrs. F. W. Lechner & Co., Ltd., 61, Spenser Street, Clerkenwell, E.C.1, have been appointed agents for the Aluminium Works, Singen, for aluminium condenser foil and electrolytic condenser foil.

Manufacturers' catalogues of artistic fittings and table standards are asked for by Messrs. T. Beadle & Co., Ltd., 3, Castle Street, Hull.

An Empire Exhibition at Adelaide

One of the main features of the celebrations being held in connection with the centenary of the proclamation of South Australia as a British Colony is an Empire Exhibition opened at Adelaide on March 20th, and continuing until May 16th.

Air Route Beacons

A batch of air beacons have recently been completed at the works of the General Electric Co., Ltd., at Wembley to enable pilots to locate their position en route between aerodromes on the Karachi-Rangoon air route. These are 8 ft. high and 4 ft. in diameter, and of 1½ kW rating. Each has a main optical system surmounted by a red obstruction light fitting. As the beacon revolves so does the main beam, the obstruction light flashing morse signals to pilots indicating the precise position of beacon en route. The beacons will be spaced from 30 to 50 miles apart along the route between aerodromes. A picture of these beacons appears on page 508.

The Met-Vick staff dining room for men

Light and Living

We have received from Messrs. Bernard Jones Publications, Ltd., 37, Chancery Lane, W.C.2, a copy of the first number of "Industrial Arts," a new quarterly magazine (2s. 6d.) devoted to the practical application of design and colour in

everyday activities. Architecture, furnishing, pottery, bookbinding and printing are some of the matters covered. From the electrical point of view the articles on "Light-Architecture," by L. Moholy-Nagy, suggesting the three-dimensional use of light, and "Lighting for Living," by A. B. Read, dealing with the illumination of interiors, are of considerable value.

Easter Holidays

The works and offices of Higgs Motors, Ltd., Witton, Birmingham, will be closed from April 10th to 14th inclusive.

A Works Lighting Installation

The lighting installation of the works of Philco Radio & Television, Ltd., has recently been modernised and over sixty Siemens" Sieray" electric-discharge lamps have been installed. As our picture shows, a high standard of lighting and visual acuity is obtained.

A Colliery Guide

The 1936 edition of *Reid's Handy Colliery Guide and Directory* (Andrew Reid & Co., Ltd., price 2s. 6d.) has been revised from the latest official returns and other sources. A colliery map giving the position of collieries as well as the railways and stations for Northumberland, Durham and Yorkshire is included, and there is also a section dealing with general regulations as to the installation and use of electricity in mines.

Social Events

The tenth annual staff dinner and dance of the Enfield Cable Works, Ltd., was held on March 28th at Chiltern Hall, Baker Street, N.W., the Earl of Verulam (chairman of the company) presiding. Following the loyal toast, Mr. A. E. Flaskett, who has recently been appointed a director, proposed the toast of the company and said he had been with the company since its inception, while the chairman and managing director (Mr. F. Plutte) had twenty-two years' service. The Earl of Verulam, who responded, said that the past year had seen the company recover the degree of prosperity which it enjoyed prior to the 1929 slump. The current year's prospects were at least as good. He referred with regret to the absence of Mr. F. Plutte owing to illness, but said that the latest reports were more favourable.

Miss Alyce Mitchell, a newcomer to the G.E.C. Dramatic Society, shared the honours with Mr. William Avenell in the farce "Nightie-Night," which the Society presented at the Fortune Theatre on Monday and Tuesday last. The story of a husband whose endeavours to smooth out the matrimonial troubles of a lady friend lead to many compromising episodes is a part which Mr. Avenell plays in his usual polished manner, and Miss Mitchell, as his jealous wife, gave a delightful performance. The remainder of the cast were old favourites, and gave the finished performances we have come to expect from them. The production was the Society's annual effort in aid of the funds of the Infants' Hospital, Westminster, which should benefit considerably.

The annual reunion dinner of the ex-British Westinghouse Association was held at the Trocadero, London, on March 20th. The occasion was the seventeenth of its kind. Mr. J. C. Whitmoyer presided over an attendance of 140 members from all parts of the country. The "Holy Forty" (those who went to Pittsburg in 1900) turned up in the record number of nine and, as usual, occupied their own table; they were Messrs. A. R. Dyer, N. Ratliff, R. H. Orbell, A. B. Longden, J. C. Calleghan, P. R. P. Souper, A. P. M. Fleming, R. R. Steel and G. Laird. Following the loyal toast came those of the "Association" coupled with the "Chairman," "Absent Friends," and the "Silent Toast" to those who had passed on during the year. Mr. A. McKinstry proposed the first toast, indulging in humorous recollections of Mr. Whitmoyer. The chairman in response said that the reunion always fulfilled its objects of providing an opportunity of renewing old acquaintances and recalling happy memories. The "Silent Toast" included Messrs. D. N. Dunlop, R. G. Hutchinson, H. H. Thompson, G. Harlow and C. Shears, who died last year. The ballot for life membership was won by Mr. "Jimmy" Rook.

A dinner and dance of the West Ham Corporation Electricity Department Sports Club ("Westric") was held on March 28th at Wickham's Restaurant, London, E.1. Mr. Townley (engineer and manager) presided, and an enjoyable evening was spent by a company of over 200. Among the guests was Alderman G. Croot, J.P., who has been associated with the undertaking for many years.

The Philco works lighted by means of Siemens "Sieray"

A general review of the Erith Electrical Exhibition which was described in our last issue

Recent Contracts

Messrs. Clarke, Chapman & Co., Ltd., have secured an order from the Fife Coal Co., valued at £32,000, for generators, together with boiler plant and auxiliaries for a power station.

Alleged Infringement of Radio Patent

The House of Lords, consisting of Lords Blanesburgh, Macmillan, Alness and Roche, on Monday, after hearing arguments extending over twelve days, reserved judgment on the appeal of the Mullard Radio Valve Co., Ltd., from the judgment of the Court of Appeal affirming the judgment of Mr. Justice Farwell, in the Chancery Division, dismissing the action which the appellants brought against Philco Radio & Television Corporation of Great Britain, Ltd., George Robinson & Son, Ltd., and London Piano & Radio, Ltd., for an injunction (and the usual ancillary relief in a patent action) to restrain the alleged infringement of the appellant company's letters patent No. 287958, dated December 24th, 1926, relating to an invention for "improvements in or relating to circuit arrangements and discharge tubes for amplifying electric oscillations."

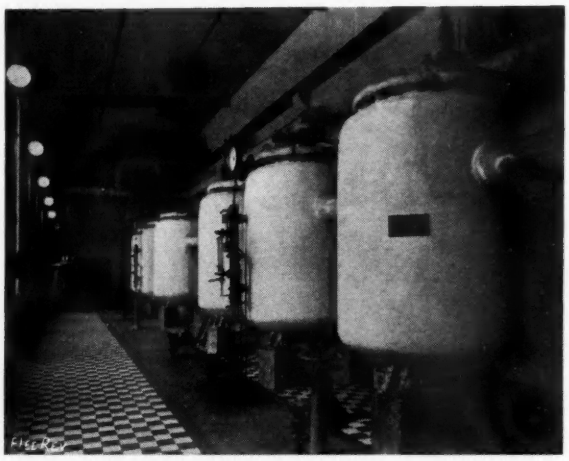
Irish Electrical Traders

The Government had expressed its willingness to consult traders before passing legislation which would affect them, but recently legislation had been enacted which had resulted in large losses to the trade, and, unlike the local traders, they had been refused compensation, said Mr. W. A. Mombrum, who presided at the annual meeting of the Society of Electrical Traders, which was held recently in Judy's Hotel, Dublin. Another reason for an active electrical organisation, he said, was that the development of electricity had attracted traders who had not previously dealt in electrical goods, particularly domestic appliances. Their personnel did not include a competent electrician, and their buyers' experience was limited to the purchase of hardware. The Society could approach the supply authorities with a view to getting them to co-operate in preventing the installation of apparatus sold under such conditions, as in the event of a serious accident those authorities would be involved.

A Large Electrode Boiler System

The Enso-Gutzeit mill, which manufactures pulp and cardboard, is situated in the immediate vicinity of the large Imatra and Rouhiala water-power plants, which have an aggregate capacity of 200,000 kW. Their off-peak power is utilised in the Enso electrode boilers, and up to date the mill has used more than 500 million kWh from Imatra. When the new Rouhiala station is completed the mill will also dispose of the off-peak power from this source. Its boiler system is being extended by 20,000 kW to 54,000 kW, and will be among the largest in Europe. The boilers are of the type designed by Niels Hall-

man and made by the Swedish firm of A/B Zander & Ingeström. A special construction of the electrodes has made it possible to load them up to 10 kV without using porcelain shields or other earthenware material below the water surface.



Electrode boilers at the Enso-Gutzeit mill

The boilers are extremely efficient in operation, and Messrs. Enso-Gutzeit state that those at their works have not involved more than £5 expenditure on repair work since 1931. The first plant (34,000 kW) comprises single-phase boilers working at 3 kV and a steam pressure of 25 atm. The latest is a three-phase 10-kV boiler operated at a steam pressure of 25 atm. The control of both electric power and steam pressure is automatic, and there is a special arrangement to keep the ohmic resistance of the boiler water at a constant value. It is expected that this new plant will operate at an efficiency of 99 per cent.

Prices of Materials

Messrs. Frederick Smith & Co. report, April 1st: No change in the price of electrolytic copper bars, wire rods and h.c. wire and silicium bronze wire.

Messrs. Henry Gardner & Co. report, April 1st: No change in the price of copper bars (best selected), sheet and rod and English pig lead. Spelter, £15 18s. 9d., 3s. 9d. decrease. English block tin, £211 5s., 15s. decrease.

Messrs. Edward Till & Co. report, April 1st: No change in the price of India rubber, Para fine.

For Sale

Poplar Electricity Department has for sale two 500-kVA transformers and four switch cubicles.

Halifax Electricity Department invites offers for the purchase of four boilers and other plant.

(See our classified advertisements.)

New Catalogues and Lists

A. Reyrolle & Co., Ltd., Hebburn-on-Tyne.—New catalogue sections dealing with kiosk sub-stations, directional relays, arc welding equipment, class "L" induction motors, and ring-main tee-off isolators. Also two pamphlets containing technical articles on metal-clad switchgear for very high voltages since 1925 and the warming of buildings by electrical thermal storage.

J. H. Tucker & Co., Ltd., King's Road, Tyseley, Birmingham.—A leaflet describing and illustrating new coloured switches and switchplugs.

Higgs Motors, Ltd., Witton, Birmingham.—A short history of the company, and catalogue sections dealing with induction motors, totally enclosed d.c. motors, and medium-sized battery charging sets.

Wingrove & Rogers, Ltd., Arundel Chambers, Strand, London, W.C.2.—A catalogue of B.E.V. electric trucks, tractors, locomotives, &c.

S. Wolf & Co., Ltd., Pioneer Works, Hanger Lane, Ealing, London, W.5.—Two leaflets dealing with the "GF6" six-inch flexible shaft grinder and the "GB7" bench and pedestal tool grinder. Also the first issue of "The Electric Tool User."

Sun Electrical Co., Ltd., 118, Charing Cross Road, London, W.C.2.—A catalogue of electrical measuring instruments, including new types of recording meters.

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.—An architectural lamp catalogue.

Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester.—A price list of ½ and ¼ h.p. single-phase motors.

Bankruptcy Proceedings

H. Shulman (trading as Shulman & Son), electrician, 5, Bayston Road, London, N.—The first meeting of creditors was held on March 30th at London Bankruptcy Buildings, when a statement of affairs were submitted showing one liability of £430 and assets "nil." The debtor states that he began trading in 1932. He invented an electrical device, a lampholder for use in gala illuminations. When the specification of the patent was published an objection was raised that it infringed another patent, but the objection was overruled, and the debtor's patent was upheld and sealed. The objector, in October, 1933, instituted proceedings in the High Court claiming an infringement of his patent, and in April, 1934, judgment was given in his favour with costs amounting to £430. The debtor paid his own solicitor's costs, but could not meet those of the plaintiff and filed his petition. The case was left in the hands of the Official Receiver to be wound up in bankruptcy.

F. Pyle, Station Road, Okehampton, Devonshire, trading as F. & E. Pyle, wireless engineer.—The adjourned first meeting of creditors of the above was held recently at 11, St. Aubyn Street, Devonport. The liabilities amount to £516, with net assets of £661, or a surplus of £145. The debtor attributed his position to defective wireless sets, competition and losses occasioned by an employé. Mr. W. J. Ching was appointed trustee of the estate with a committee of inspection.

R. Field, 61, Drewton Street, and 156, Westgate, both Bradford, electrical engineer.—The public examination herein was held on March 24th at the County Court, Manor Row, Bradford. According to the statement of affairs filed there were gross liabilities of £384, and a deficiency of £303. Debtor attributed his failure to shortage of capital, loss on contract, and insufficient turnover. The examination was closed.

H. L. Ruff, 141, Abbeydale Road, Sheffield, electrical engineer.—The first meeting of creditors herein was held at the Official Receiver's Offices, Figtree Lane, Sheffield, on March 25th, when it was stated that there were unsecured liabilities of £58 and a deficiency of £30. The matter was left in the hands of the Official Receiver as trustee.

E. T. Shaw, electrician, 17, Johnstone Road, East Ham, Essex.—Receiving order made March 20th on debtor's own petition. Public examination May 19th at Bankruptcy Buildings, Carey Street, W.C.

P. M. Gill (Swinton Radio Service), radio and electrical dealer, 166-170, Partington Lane, Swinton, and Radio House, The Circle, Davyhulme.—Receiving order made March 19th on debtor's own petition. First meeting April 3rd at the Official Receiver's Offices, Byrom Street, Manchester. Public examination May 20th at the Court House, Salford.

D. J. Spire, electrical engineer, Market Place, Bourne, Lincs.—Last day for receiving proofs for dividend April 7th. Trustee, Mr. W. A. J. Osborne, Balfour House, Finsbury Pavement, E.C.

H. Hawkins, wireless dealer, 171a, King Street, Fenton, Stoke-on-Trent.—First and final dividend of 3s. 1d. in the £, payable March 30th, at 12, Lonsdale Street, Stoke-on-Trent.

J. W. Hackett, radio and electrical engineer, 11, Paxton Terrace, Barrow-in-Furness.—Receiving order made March 24th on debtor's own petition.

N. H. P. Jones, electrical contractor, 15, North Street, Dowlais.—First meeting April 3rd at the County Court Offices, Merthyr Tydfil. Public examination April 15th at the Town Hall, Merthyr Tydfil.

M. Cohen (Lightning Radio), 2, Priestfield Road, Ellesmere Port.—Trustee, Mr. J. Allcorn, Government Buildings, Victoria Street, Liverpool, Official Receiver, released March 16th.

W. B. Ralphs, electrical contractor, 30, Ayresome Street, Middlesbrough.—Trustee, Mr. C. L. Townsend, 80, High Street, Stockton-on-Tees, Official Receiver, released March 17th.

Company Liquidations

Architectural Lighting, Ltd., 39, Berners Street, London, W.1.—The statutory meeting of creditors in this matter was held at the above address recently, when one of the directors of the company occupied the chair. A statement of affairs as at March 19th last was submitted showing liabilities of £1,955, of which £1,805 was due to trade and other creditors, and there was £150 due to deferred creditors. The net assets were £3,223, with an estimated surplus, subject to contingent liabilities and expenses of realisation, of £1,269. It was reported that the company was formed on November 30th, 1934. The present meeting was called at the instance of the directors because negotiations for the sale of the business as a going concern had fallen through. The creditors passed a resolution for the appointment of Mr. E. Boswell Phillips, of 8, Frederick's Place, London, E.C., as liquidator of the company, with a committee of inspection consisting of the representatives of Messrs. R. Robinson; Tunewell Neon and Radio, Ltd.; Liverpool Electric Co., Ltd.; and A. J. Miller and Co., Ltd.

English Relay Wireless, Ltd.—Winding up voluntarily. The company is being amalgamated with British Relay Wireless, Ltd., and the liquidator, Mr. N. F. C. Forsyth, is authorised to execute an agreement for the amalgamation and the transfer of the business of the company.

Rhymos, Ltd.—Particulars of claims to the liquidator, Mr. W. A. J. Osborne, Balfour House, Finsbury Pavement, E.C., by April 10th.

International Electrical Supplies Co., Ltd.—Particulars of claims to the liquidator, Mr. W. A. J. Osborne, Balfour House, Finsbury Pavement, E.C., by April 10th.

Torque Transformer Syndicate, Ltd.—Meeting April 28th at 7, Great Winchester Street, E.C., to receive an account of the winding-up by the liquidator, Mr. A. G. Howard.

Green & Jackson, Ltd.—Meeting, April 23rd at Alston Buildings, Spiceal Street, Birmingham, to receive an account of the winding-up by the liquidator, Mr. J. E. Hartles.

Private Arrangements

G. H. Todhunter, trading as Harwol Specialities, Strand Street, Liverpool, electrical fittings dealer and electrical engineer and merchant.—At a meeting of creditors a statement of affairs presented showed ranking liabilities of £930, of which £860 was due to the trade and £70 to the bank, which claimed £750, and held security valued at £680. After allowing £91 for preferential claims the net assets were £439, leaving a deficiency of £491. During the first two years the business was successful, net profits of approximately £1,000 per annum being earned. The business was mainly with shipping firms and owing to the state of that industry the turnover declined. During the twelve months to August 31st, 1935, the turnover was £3,781 with a gross profit of £889 and a net profit of £36, whilst the drawings were £380. The opinion was expressed that the business should be continued and it was decided that the deed of assignment already executed to Mr. J. A. Ross should be confirmed. A committee was also appointed.

Electricity Supply

Lighting, Domestic, Power

Australia. — COUNTY ELECTRICITY OFFICES. — The Sydney County Council, which recently took over the control of the municipal electricity supply, has arranged with the City Council to resume occupation of the whole of the Victoria Building and to make it the electrical centre for the State. A rental of £25,000 has been accepted by the City Council. At present only part of the building is occupied by the electricity staff, and it is expected that the building will now be used for large displays of electrical appliances.

Birkenhead.—SUB-STATION CONSTRUCTION.—It is proposed to carry out extensive sub-station works, chiefly additions to existing buildings, at an estimated cost of approximately £20,000.

Denmark.—ELECTRICITY CONSUMPTION.—On the basis of reports from 96 per cent. of the power companies the total consumption of electricity in 1935 is given as 647 million kWh, which is 11.2 per cent. more than in 1934. Home production decreased by 18.8 million kWh to 566 million kWh, while imports of power from Sweden rose from 38.6 to 89.7 million kWh. Exports of Danish-produced power, at the same time, decreased from 41 to 8¼ million kWh, states our Copenhagen correspondent.

Dewsbury.—SODIUM LIGHTING.—The Corporation has installed six sodium electric-discharge lamps in the market place for trial purposes.

Edinburgh. — EXTENSIONS AT PORTOBELLO. — The Public Utilities Committee has approved, in principle, a scheme of extensions to Portobello power station, which will probably cost about £350,000.

Formby.—REVISION OF TARIFFS.—At a recent meeting of the Urban District Council it was decided that the lighting flat rate for electricity should be raised from 6d. to 7d. per kWh and other tariffs revised, the all-electric house rate being discontinued. In presenting the minutes, Coun. Willcox stated that since the charges had been reduced a reserve fund of £4,500 had been absorbed by losses. The undertaking, which was comparatively young, had never been assisted out of the rates, despite the heavy charges it had to bear for bulk supply during the first ten years; the scattered nature of the district, involving considerable loan charges for mains; and the schemes embarked upon for hiring out apparatus to encourage and increase the use of electricity for domestic purposes, again involving heavy loan charges.

France.—WATER POWER IN PARIS.—Water power is likely eventually to supply all the electricity needed in Paris, learns *Reuter's Trade Service*. By means of a 220,000-V underground cable 20 km. long, which is oil-filled and carries a three-phase reactive load of 70,000 kW, it has been possible to complete the link between the capital and the Alp and Rhine hydro-electric stations. The supply is connected with the system surrounding Paris on which the various distributing stations are situated.

Grangemouth.—BAN ON ELECTRICITY LIFTED.—As the Scottish Central Electric Power Co. has reduced the fixed charge for two-apartment houses, the Town Council has agreed to lift the ban on electricity in municipal houses; 172 houses now under construction are to be wired for electricity, and tenants of existing houses will be free to open negotiations with the company.

Grimsby.—RURAL SUPPLIES.—A supply is to be given by the Electricity Committee to Ludborough, Utterby and North Ormsby, at a cost of £6,230.

LOAN.—Sanction is also being sought to a loan of £16,000 for distribution works.

Hartlepool.—SALE OF POWER STATION.—The South Durham Steel & Iron Co. proposes to buy the West Hartlepool Corporation's generating station. It was opened in 1912 to use waste heat from the blast furnaces, but when the latter closed the station had to be reorganised for coal firing. The station itself was shut down five years ago when the North-Eastern Supply Co. took over the town's supply.

Harwich.—REVISED CHARGES.—Mr. J. H. Shepherd, the borough electrical engineer, has sent us details of the latest scales of charges. There is a sliding flat rate and, as an alternative, a two-part tariff based on the rateable value of premises, with a running charge of ¾d. per kWh. Special rates are available for thermal-storage water heating, vehicle-battery charging and power. Both assisted wiring and simple hire of wiring are available, and domestic apparatus may be obtained on hire or hire-purchase terms.

Holland.—A 150,000-V TRANSMISSION LINE.—What is described as the first 150,000-V transmission line in Holland has just been completed between Geertruidenberg and Eindhoven. The line forms part of the projected plan of inter-connection of all the principal power distribution systems in the country, and has been equipped with circuit-breakers with a breaking capacity of 1,500,000 kVA.

Hungary.—DISTRIBUTION PROGRESS.—In a recent issue of the *Elektrotechnika* (Budapest) Mr. P. Kuzaila gives particulars of the development of l.v. distribution systems in Hungary during 1934. Altogether 123 miles of main transmission lines were erected and 204 miles added to the distribution network, an aggregate of 327 miles, of which 287 miles were for three-phase supplies, 31½ miles for single-phase and the remainder for d.c. At the end of the year the total length of the main transmission and distribution systems amounted to nearly 13,590 miles, of which 6,834 miles were h.v. and 6,756 miles l.v.

Italy.—MAINTAINING TRACTION VOLTAGE.—A special travelling rectifier sub-station has recently been supplied by the Siemens-Schuckert Works Co. to the Societa Tranvie e Ferrovie Elettriche, of Rome, for use on its electric tramway and suburban railway systems. It can be put into operation at any point, and, after connection, its operation is entirely automatic. The apparatus is started up after the trolley-wire voltage has fallen below a certain level for a prearranged time, and is automatically stopped as soon as the power supplied by the rectifier drops below a determined value, indicating that the demand on that particular section of the system has reverted to its normal level.

Kingston-on-Thames.—LOANS.—The Corporation has applied for loans of £3,000 for the assisted-wiring scheme, £16,000 for mains, and £4,000 for sub-stations.

Java.—AN AUTOMATICALLY CONTROLLED HYDRO-ELECTRIC POWER STATION.—Work is in hand at Tjinangling on the construction of a hydro-electric power station which, although of relatively small capacity, is interesting in that it will be remotely controlled. The equipment will comprise two Escher Wyss, Francis-type 1,700-h.p. turbines and a Siemens-Schuckert 2,250-kVA alternator, which, working under a head of 246 ft., will generate electricity at 6,300 V at 1,000 r.p.m. The alternator is being installed between the two turbines, and the control is to be so arranged that in the dry season it can be driven by one or other of the turbines, and in the wet season by both. The power is to be stepped up by a 2,250-kVA transformer to 25,000 V, and then transmitted to the system connected with two other hydro-electric plants and a steam-operated generating station in the same district.

Llandudno.—ILLUMINATIONS.—The Electricity Committee has been requested to prepare a scheme of autumn illuminations The cost is not to exceed £3,000.

London.—BATTERSEA.—At a cost of £720 the Electricity Committee is to have ninety-four premises wired for electricity.

HAMPSTEAD.—The Electricity and Lighting Committee has recommended the installation of new plant and cables during the coming year at a cost of over £27,000.

An aerial photograph of the Boulder Dam across the Colorado River, which last month was taken over by the United States Government without a formal ceremony. The construction work, costing $54,700,000, has been completed two years before the scheduled time

ST. PANCRAS.—The chief electrical engineer and manager (Mr. R. Lee) has reported that, owing to the increasing use of electricity in the northern part of the borough, he considers it advisable that the system should be changed from d.c. to a.c. at an estimated cost of £39,197. The present number of consumers that would be affected is 2,762.

Mains are to be extended by the Electricity Committee at a cost of £1,365. A sub-station is also to be provided in Britannia Street, primarily to afford a supply to new printing works being erected there.

HAMMERSMITH.—The Electricity Committee is to connect up cables between the power station and the North Pole sub-station at a cost of £2,000 for cables and £800 for switchgear. Estimates for the next twelve months approved by the Electricity Committee include the following: Sub-stations and equipment, £25,500; generating station switchgear, £6,000; cables and services, £25,000; meters, £7,000; hired installations

and apparatus, £11,000; and changing the pressure, £25,000.

Poplar.—The Electricity Committee is to extend its mains at a cost of £8,528. It also reports that in September, 1934, it reduced the "unit" charge for domestic supplies from 0.75d. to 0.6d. This concession resulted in a large increase in the domestic supply, and the Committee now recommends a further reduction to 0.5d. per kWh.

Deptford.—Tenders are to be invited for the re-wiring of the Town Hall.

Manchester.—Loans.—The Electricity Committee is seeking sanction to borrow £350,000 for feeder and distribution mains and £10,456 for switchgear.

Newcastle-upon-Tyne.—Corporation to Take Over Supply.—The City Council has instructed the Transport and Electricity Committee to submit a scheme for the supply by the Corporation of electricity to Benwell and Fenham, and has decided to terminate the present arrangement whereby the Corporation's powers are delegated to the Newcastle and District Electric Lighting Co.

Oakham.—Extensions.—Plans submitted by the Mid-Lincolnshire Electric Supply Co., Ltd., in respect of overhead cables at Hambleton and Empingham, and surface wiring at Market Overton, have been approved by the Rural District Council.

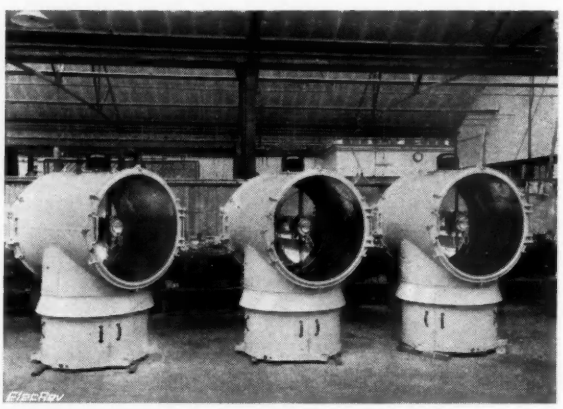
Preston.—New Feeder.—A recommendation has been passed by the Electricity Committee for the laying of a new feeder to run to the area north of Preston. The cost is estimated at £12,750.

Salisbury.—Church Lighting.—It is reported that during 1935 electric lighting was installed in thirty-one churches in the diocese, making the total number electrically illuminated 125.

Seaham Harbour.—A Reduced Tariff.—The Urban District Council has decided to modify its lighting tariff. For consumptions up to 100 kWh per month the rate will be 5½d. instead of 6d. per kWh, and from 100 to 500 kWh per month 4½d. (5d.) per kWh.

Distribution Reconstruction Scheme.—The electrical engineer recommends the reconstruction of the whole distribution network, many of the lines being too small for present conditions.

Stalybridge and District.—Assisted Wiring Scheme.—The Stalybridge, Hyde, Mossley and Dukinfield Joint Electricity Board has introduced a new assisted wiring scheme. The fixed weekly charge of 11¾d., which is payable through a two-part tariff prepayment meter, covers the fixed charges under the domestic "all-in" system and the repayment of the cost of the installation, electricity being supplied at ½d. per kWh. The installation becomes the property of the consumer at the end of seven years.



The G.E.C. 1½-kW beacons for the Karachi-Rangoon air route. **(See page 504)**

Surrey.—Inquiry.—Objections of landowners and others to proposals of the London and Home Counties Joint Electricity Authority for the erection of h.v. overhead lines from Westcott to Abinger Hammer and from Broadmoor to Coldharbour were the subject of a Ministry of Transport inquiry last week. Mr. F. W. Purse, in evidence and in the course of cross-examination, said that the plans for the Westcott to Abinger Hammer scheme had always been for overhead lines (it was suggested that there had been an intention to put in underground cables). In the case of the other line, anyone who knew the nature of the ground would appreciate that the laying of underground cables could not be done mechanically. It would probably be necessary to use dynamite. His personal opinion was that the proposed line would not cover any more beautiful ground than in other parts of the authority's system. The J.E.A. had endeavoured, he thought successfully, not to destroy amenities. A petition in favour of the Broadmoor scheme was submitted on behalf of the majority of the inhabitants.

Thornton Cleveleys.—Electrical Development.—Improvements and extensions are to be made in the street-lighting system, while the Council is applying for permission to borrow £1,350 for electrical plant. It has been decided to supply electricity to occupiers of caravans.

Wallasey.—Revised Charges.—As from April 1st the Electricity Committee has recommended that the following charges should come into force: Lighting (supplied through prepayment meters), reduction to ¼d. per kWh (as against ½d.) above the current flat rate; heating, lighting and power for electrical showrooms, 1d. per kWh, with a discount of ten per cent. on consumption in excess of 250 kWh per quarter.

Wimborne.—Electricity for Stapehill.—The Rural District Council has consented to the erection of overhead lines at Stapehill by the Bournemouth and Poole Electricity Supply Co., Ltd.

Traction

Canada.—Electric Railways.—In 1934, for the first time since 1929, there was an increase in the number of passengers carried by Canadian electric street and suburban railways, the total recorded being 595,143,903, as against 585,385,094 in 1933. The traffic was, however, still below that of 1932 and of any previous year back to pre-war times. Gross revenues also improved for the first time in five years, increasing from $39,383,965 in 1933 to $40,048,136. The net income for all railways increased from $5,070,581 to $6,191,101, the mileage operated being reduced by from 1,864 to 1,850 miles.

Ipswich.—Trolley-bus Extensions.—A scheme for the extension of the trolley-bus system at a cost of £15,120 has been approved by the Transport Committee.

Manchester.—Committee to Consider Tube Railway Proposal.—The Nomination Committee has appointed a Special Committee of nine members to consider the proposed scheme for an underground railway in Manchester.

Russia.—Electric Traction Progress.—The *Monthly Review* of the U.S.S.R. Trade Delegation in Great Britain reports that further work on the electrification of the Moscow branch railway will be commenced shortly. The present length of the electrified track on this line of 106 miles will be increased to 152 miles. Electrification will also be carried out on certain sections of the Northern Railway, namely, those between Tomsk-Monino (seven miles) and Zagorsk-Alexandrov (twenty-seven miles). The first of these will be put into operation this autumn, and the second before December.

Surrey.—Photo-electric Control of Traffic Lights.—A system of pedestrian and traffic control by photo-electric ray-operated light signals was to be opened at St. Helier Avenue, on the Sutton by-pass road, yesterday (Thursday).

Sweden.—Opening of Electrified Railway.—The recently electrified line from Stockholm to Aange is to be opened for electric traffic early this month, learns *Reuter's Trade Service* from Stockholm.

Communications

Canada.—Broadcasting.—The draft of a Bill in which it is proposed to repeal the Canadian Radio Broadcasting Act of 1933, abolish the present Radio Commission, and substitute for it a new Broadcasting Corporation with a board of seven directors and a general manager, has been submitted to the House of Commons Radio Committee by Mr. C. B. Howe, Minister of Railways and Canals. The draft will form the basis for an inquiry which will begin with public meetings on Tuesday next. Under the proposed Bill the Corporation would take over the assets of the present Commission and all national broadcasting under a licence from the Minister. The control of private broadcasting stations which now rests with the Radio Commission would be transferred to the Minister, but in regulating such stations he would consult and co-operate with the new Corporation. The draft is intended as a guide for the committee, and there is nothing to indicate that it represents the final decision of the Government. Two of the directors would represent the Dominion. Others would represent Ontario, Quebec and the maritime and prairie provinces and British Columbia.—*Reuter.*

Great Britain.—Telephony.—It is announced that the present additional charges on calls to the Continent made from counties more than 100 miles from London are to be abolished. A service is now available from this country to Tasmania at the same rates as the calls to the mainland of Australia.

Radio Relays.—A statement has been issued by Broadcast Relay Service, Ltd., in connection with the recommendations contained in the report of the Ullswater Committee. With regard to the committee's suggestion that there may be better alternative methods of operating relay services, either over telephone lines or electric mains, the company states that in the first case an amplifier requiring electricity would be needed. Many relay subscribers had no electricity, and not more than five per cent. had telephones. The use of electric mains had been investigated in the United States for over seven years, but no conclusive result had been reached.

Sixpenny Telegrams Justified.—The Post Office reports that the number of telegrams dealt with since the introduction of the sixpenny tariff continues to show a large increase over last year and has fully justified the step. An increase of 33.4 per cent. was recorded during the twelve months ended March 9th, 1935.

Aids for Aircraft.—The Municipal Airport Committee is to

recommend the City Council to spend £5,500 on the installation of directional radio and night-landing lighting at the new airport.

India.—MYSORE PLANS.—The Government of Mysore has sanctioned the expenditure of Rs. 600,000 on improvements in the telephone service in the cities of Bangalore and Mysore. The present automatic telephone exchange in Bangalore provides for 200 lines and that in Mysore for 100 lines. An order has already been placed for an automatic exchange capable of dealing with 500 lines in the first instance and of expansion to 2,000 lines by steps of 500.

Irish Free State.—TELEPHONE CONCESSIONS.—A reduction in the annual telephone rental from £7 10s. to £6 in the case of business and £5 for residential instruments has been announced by the Department of Posts and Telegraphs. The free mileage, states *The Times*, will be extended from one to three miles; the local fees on trunk calls will be abolished and a general reduction is to be made in the cost of trunk calls. The maximum charge during the day will be 2s. 6d. in the Free State, and 4s. to Great Britain and Northern Irleand. A 1s. night rate will be in force throughout all parts of the Free State and for calls to the United Kingdom.

Lithuania.—HIGH POWER BROADCASTING STATION.—The 7 kW transmitter at Kovno (Kaunas) is to be replaced by a new one of 50 or 100 kW. The Lithuanian Broadcasting Company has allotted a sum of 2,000,000 Lits for the purpose, and tenders have already been received from Germany, England, and Russia. Our Scandinavian correspondent also reports that the erection of a national short-wave broadcasting station is contemplated.

Norway.—RADIO EQUIPMENT FOR SEALERS.—A fleet of sealers is about to be equipped with radio-telephone short-range equipment so that the smaller vessels can communicate with the chief ship of an expedition.

NEW CABLES.—A recent cabinet meeting at Oslo decided to make a grant for the construction of three new high-frequency broadcasting cables to link Oslo, Notodden, Kristianssand and Stavanger, Oslo and Bergen, and Oslo and Aalesund.

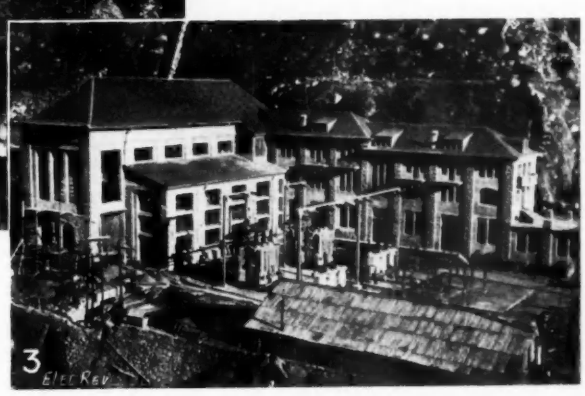
TELEPHONE NATIONALISATION PROGRESS.—The Post Office, in a special report, points out that despite the Government's efforts to nationalise telephone services there are still a large number of private telephone companies. According to a census taken at the beginning of this year there are no fewer than 250 private companies working 58,490 lines. The Post Office controls 155 exchanges with 73,862 subscribers. The total number of apparatus in the country is 176,734, of which 55.07 per cent. are public and 44.93 per cent. private.

Sweden.—NEW RADIO STATION.—Our Scandinavian correspondent reports that the Swedish Postmaster-General has placed a contract for the erection of a 100-kW regional broadcasting station at Hörby (Scania) with the Telefunken Co. Preparatory work is already in progress. The new transmitter will be of a similar design to those at Berlin, Hamburg, Breslau, and Langenberg (Cologne).

Turkey.—TELEPHONE EXTENSIONS.—The *Journal des Télécommunications* reports that the Turkish Ministry of Public Works is making arrangements for a considerable extension of the telephone system. Included in the scheme are new lines to connect the country with Russia, Iran (Persia), Iraq and Syria.

Power from Andorran Streams

IN a country as mountainous as Andorra, the small republic in the Eastern Pyrenees, the water power resources are considerable in proportion to its size, but their utilisation is complicated as most of the watercourses are small. For the new power station at Escaldes the problem is being solved by drawing water from the Valira and Madriu Rivers and also from a number of tributaries. The part of the scheme appertaining to the Valira has now been completed. Dams have been constructed across the river itself and twelve tributaries, a certain amount of water being led from each by a canal to Lake Engolastiers, which forms the reservoir for the power plant situated at the foot of a hill 470 ft. below.



(1) Lake Engolastiers, the reservoir for the Escaldes hydro-electric plant. (2) The conduit between Lake Engolastiers and the power station. (3) Escaldes power station

At each dam there is an intake decantation chamber in which sand can be removed. The water thus collected in the canal is calculated to give a mean output of four cubic metres per second. The fall over the total length of 10.9 kilometres is 0.0015 per cent. This canal passes for a great part of its length through tunnels, and is built along the sides of the hills on the left bank of the Valira. The intakes in the valley of the Madriu will be on the same principle and will begin at the junction of that river with the Perafitta. The total length of the canal will be 4 km.

Lake Engolastiers is in a granite bed that was once part of a valley since dammed up by glacial drift. It has no natural outlets or affluents. In order to increase its usefulness as a reservoir, it was decided that its height should be raised from 17 to 26 metres. The dam which has been contructed consists of a concrete triangle containing a gallery for inspection, and is faced on the outside with a double heavy layer of granite blocks in masonry. An existing gulley in the granite was used for part of the way in the construction of a channel to carry off the superfluous water.

From one end of the lake an intake conduit runs down to the plant. A tunnel sunk below the surface of the water and covered by a grill prevents solid matter from getting into the conduit, whose diameter of 1.9 metres at the upper end narrows down to 1.4 metres at the lower. Its total length is 980 metres. The upper section of the conduit is made of electrically welded steel tubing varying in thickness between 8 and 15 millimetres, hooped for extra protection. With a fall which varies between 33 and 77 per cent., the mean output of the conduit is 10 cu. m. per sec.

For the present, two turbines are connected to this conduit. A third will be added when the Madriu feed is completed.

The tail race of the Pelton vertical-type turbines runs to a canal along one side of the plant; it is intended to use this canal later for a second plant to be built farther down the valley. Each turbine runs at 600 r.p.m. and with a head of 460 metres has a capacity of 17,500 h.p. To each turbine is connected a 50-cycle, 6,300-V, 16,700-kVA generator with an exciter mounted at the end of the shaft. A third turbine and generator with a pump set will eventually be installed. At one side of the building is situated the open-air sub-station with, at present, two 6,300/135,000-V step-up transformers and the cut-out switches controlling them. The transformers feed bus-bars from which the high-voltage line runs to the region of Barcelona, where it is connected with the Spanish high-voltage network.

Contract Information

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Contracts Open

Argentina.—BUENOS AIRES.—April 13th. State Oilfields Directorate. Diesel engines and generating sets. (T.Y. 5790.)*

Australia.—MELBOURNE.—April 14th. Deputy Director, Posts and Telegraphs. V.i.r. l.c. cable. (T.Y. 40008.)*

Barnes.—April 14th. Electricity Department. Mercury-vapour rectifier plant. (March 20th.)

Blackpool.—April 21st. Electricity Department. Meters for one year. (March 27th.)

April 25th. Corporation. One 1,000-kW steel tank rectifier and equipment. (See this issue.)

Bristol.—April 15th. Electricity Department. E.h.p. and l.p. switchgear. (March 27th.)

Bury.—April 16th. Electricity Department. One year's supply of e.h.p. sub-station switchgear. (See this issue.)

Caerphilly.—April 6th. Electricity Department. E.h.p. truck type cubicle, kiosk, transformer, e.h.p. circuit-breaker and l.p. gear, e.h.p. and l.p. cables, &c. (March 20th.)

Cardiff.—April 14th. R.D.C. Electricity Department. E.h.p. and l.p. lines and e.h.p. switchgear, and one 50-kVA outdoor transformer. (March 27th.)

Cheadle & Gatley.—April 8th. Electricity Department. 6.6-kV feeder. (March 20th.)

Chesterfield.—April 9th. Electricity Department. E.h.p. and l.p. cables. (March 27th.)

Dalkeith.—April 11th. Town Council. Electrical work in 159 houses. Morham & Brotchie, surveyors, 29, Hanover Street, Edinburgh.

Darlington.—April 20th. Corporation. Mercury-arc rectifiers. (See this issue.)

Dundee.—April 7th. Electricity Department. Meters for one year. (March 20th.)

Dunfermline.—April 8th. Town Council. Electric lighting of 128 houses on the Headwell housing scheme. Borough engineer (deposit £1 1s.).

Egypt.—CAIRO. April 30th. Ministry of the Interior. 525 single-phase and seventy-five three-phase electricity meters. (T.Y. 10434.)*

April 30th. Public Works Department. Electrical material, including lamps, domestic wiring supplies, battery plates, house-service meters, street lighting poles and lanterns. (T.Y. 10436.)*

June 9th. Mechanical and Electrical Department, Ministry of Public Works. Two boilers and one 5,000-kW turbo-alternator set complete with auxiliaries, switchgear, transformers, &c., and two house turbo-alternator sets with building work at the Atf power station. Chief inspecting engineer, Egyptian Government, 41, Tothill Street, London, S.W.1 (deposit £5 2s. 6d., not returnable).

Erith.—April 8th. Electricity Department. One 6,000-kVA outdoor type transformer. (March 27th.)

Gainsborough.—April 18th. Electricity Department. Switchboard and transformer. (See this issue.)

Glasgow.—April 11th. Lighting Department. Electrical fittings and accessories. Lighting Department, 20, Trongate.

Hastings.—April 30th. Electricity Department. Switchboard and two transformers. (See this issue.)

Heston and Isleworth.—April 20th. Electricity Department. Transformer and switchgear. (See this issue.)

Kirriemuir.—April 9th. Town Council. Electric lighting at housing estate. J. S. Bruce, borough surveyor (deposit 10s.).

Leeds.—April 16th. Housing Committee. Maintenance repairs, including electrical, at housing estates (Group Nos. 3 and 4, containing approx. 5,370 dwellings). R. A. H. Livett. housing director, 26, Great George Street (deposit £2 2s. for each group).

April 20th. Electrical installations on housing estates. (See this issue.)

London.—ISLINGTON.—June 10th. Borough Council. Street lamp columns, emergency battery, installation of fire-resisting apparatus in connection with new switchgear, and transformers. (See this issue.)

STEPNEY.—April 27th. Electricity Department. Electrical materials for one year. (See this issue.)

Lowestoft.—April 15th. Electricity Department. Cables. (See this issue.)

Manchester.—April 16th. A.c. motors, time switches, kettles, and meters for one year. (March 27th.)

Mexborough.—April 14th. Electricity Department. E.h.p. and l.p. cables. (March 27th.)

Morecambe and Heysham.—April 17th. Electricity Department. Materials for one year. (See this issue.)

Newport Pagnell.—April 14th. R.D.C. Engineering tools, including electrically driven lathe, drill, tapping and screwing machines, &c., at the waterworks pumping station. Taylor & Wallin, 1, Saville Place, Newcastle-upon-Tyne (deposit £1).

New Zealand.—WELLINGTON.—June 5th. Post and Telegraph Department. Eight miles of single solid conductor rubber-insulated taped and braided cable. (T.Y. 10447.)*

May 25th. Galvanised earth rods. (T.Y. 30005.)*

Northern Ireland.—BELFAST.—April 20th. Electricity Department. Current limiting resistances and 33-kV switchgear and protective equipment. (See this issue.)

Perth.—April 11th. Corporation. Electric lighting in 234 houses. T. McLaren, borough surveyor (deposit £1).

Portsmouth.—Electricity Department. Installation of electric sign. (See this issue.)

Prestatyn.—April 18th. Electricity Department. L.p. cables, joint boxes, cutouts, &c. (See this issue.)

Salford.—April 14th. Electricity Department. Electrical installation in 200 houses. City electrical engineer, Electricity Department, Frederick Road.

South Africa.—JOHANNESBURG.—April 18th. City Council. Pole mounting cut-outs during twelve months commencing June 1st, 1936. (T.Y. 10443.)*

May 5th. Rand Water Board. One 3,000-kW steam turbine-driven alternator with auxiliaries, &c., and switchgear. (T.Y. 40017.)*

CAPE TOWN.—April 29th. Electricity Department. Two electric passenger lifts. (T.Y. 5816.)*

Southend-on-Sea.—April 6th. Corporation. Electrical refrigerator installation at the Public Mortuary. R. H. Dyer, borough engineer, Municipal Buildings (deposit £1).

April 7th. Electricity Department. Strip lighting, colour mediums and angle iron. (March 27th.)

Uruguay.—MONTEVIDEO.—May 12th. State Electricity Supply and Telephones Administration. Insulated copper conductors for outdoor use. (T.Y. 10446.)*

Warrington.—April 20th. Electricity Department. Transformers. (See this issue.)

West Ham.—April 4th. Electricity Department. 6.6-kV switchgear for one year. (March 20th.)

* Further particulars from the Department of Overseas Trade (Inquiry Room), 36, Old Queen Street, London, S.W.1.

Contracts Closed

Birkenhead.—Electricity Committee. Accepted. Cable (£2,048).—Macintosh Cable Co. Rectifier equipment at Marshall Street and Cleveland Street sub-stations (£6,980).—Hewittic Electric Co. Wiring under assisted scheme: Twenty-nine houses (£122).—L. W. Bryan. Fifty-one houses (£203).—Park Electrical Co. Two 100-kVA transformers (£107 each) and supply of transformers for twelve months.—G.E.C.

Dartford.—Town Council. Accepted. 230-kW water heater for the swimming baths (£590).—A. Reyrolle & Co.

Ipswich.—Electricity Committee. Accepted. Switchgear (£1,115).—Harland Engg. Co.

Jarrow-on-Tyne.—Town Council. Accepted. Electric wiring in 830 houses.—J. McCabe.

Lancaster.—Corporation. Accepted. Cables and overhead lines for extensions in the rural area.—British Insulated Cables, Ltd.

Leeds.—Electricity Committee. Accepted. Cookers for twelve months.—Carron Company; Revo Electric Co.; Falk, Stadelmann & Co. Cable.—Macintosh Cable Co. (£785); Henley's (£560); Edison Swan Cables (£654); Derby Cables (£837); Enfield Cable Works (£420); T. C. and M. Co. (£244); Hackbridge Cable Co. (£406).

Liverpool.—Electric Power and Lighting Committee. Recommended. Supplies for twelve months: Cables, compounds and tapes.—Callender's; Rotunda, Ltd.; B.I. Cables. Insulated cables.—Mersey Cable Works; Liverpool Electric Cable Co.; Henley's. Electric motors and starting gear.—Higgs Motors; Howells (Electric Motors); Morecambe Electrical Equipment Co.; Erskine, Heap & Co. Electric cookers, kettles and washboilers.—Elexcel, Ltd.; Bulpitt & Sons.

London.—L.C.C. Accepted. Wiring and fittings for electric lighting, power, internal telephones and domestic bells at the new reception block, St. Leonard's Hospital, Shoreditch (£490).—Francis Polden & Co. This was the lowest of nine tenders, the highest being £950. Electric lighting and power installations at residential school, Anerley (£592).—R. C. Cutting & Co.

Electric bed lift at the Hackney Institution, Homerton:

	£
Pickerings, Ltd. Accepted	**755**
Marryat & Scott, Ltd.	960
Express Lift Co., Ltd.	1,002
J. and E. Hall, Ltd.	1,032
Waygood-Otis, Ltd.	1,070

POPLAR.—Electricity Committee. Accepted. Two economisers (£1,502).—E. Green & Sons. Scraper chain for ash conveyor (£216).—International Combustion, Ltd.

STOKE NEWINGTON.—Electricity Committee. Recommended. New service equipment in connection with the change of supply in the Church Walk area (£80).—English Electric Co. Two further units for the extension of the e.h.p. switchboard at the Wordsworth Road sub-station (£525).—G.E.C. Supplies during the twelve months ending March 31st, 1937: E.h.p., pilot and l.p. cables.—Henley's. Underground disconnecting boxes and pavement frames.—G. P. Cosway. Meter boards.—Caxton Wood Turning Co. House service meters.—Chamberlain & Hookham; Thompson & Co.; Smith Meters; Aron Electricity Meter, Ltd. Washboilers.—Alder Electrical Appliances. Electric water heaters: Non-pressure type, pressure type and combined feed tank and pressure type storage heaters.—Simplex Electric Co.; 12/15 gal. 4-kW heaters with cut-off switches.—Santon, Ltd. Immersion heaters, flanges and thermostats.—Arch. Low Electrics. Installation work (extension of existing contract).—W. B. & H. C. Cables.

WESTMINSTER.—Works Committee. Recommended. Renewal of electrical wiring at Grosvenor Road disinfecting station (£135).—Buchanan & Curwen.

Cleansing Committee. Recommended. Induction control rectifier (£126) and spare bulb (£25).—Nevelin Electric Co.

Manchester.—Electricity Committee. Recommended. Electric cookers for twelve months.—Carron Company; Simplex Electric Co.; G.E.C.; Moffats; Revo. Six 6-kV single-conductor cable.—Liverpool Electric Cable Co.; B.I. Cables. Repairs to 6,000-kVA transformer.—Ferranti. 33,000-V switchgear for the Stuart Street and Droylsden East sub-stations.—Reyrolle; Ferguson, Pailin. Supervisory control gear at the Failsworth and Sale sub-stations.—Standard Telephones.

Middlesex.—Health Committee. Installation of electric lifts: West Middlesex Hospital:

	£
Marryat & Scott, Ltd.	584
Etechells, Congdon & Muir, Ltd. Accepted	**682**
Express Lift Co., Ltd.	720
Hammond Bros. & Champness, Ltd.	765
Waygood-Otis, Ltd.	949

Edgbury Convalescent Home:

	£
Marryat & Scott, Ltd.	399
Etchells, Congdon & Muir, Ltd. Accepted	**448**
Hammond Bros. & Champness (1933), Ltd.	516
Waygood-Otis, Ltd.	583
Express Lift Co., Ltd.	620

Harefield Sanatorium:

	£
Pickerings, Ltd. Accepted	**1,676**
Marryat & Scott, Ltd.	1,787
Hammond & Champness (1933), Ltd.	2,111
Gimson & Co. (Leicester), Ltd.	2,323
J. & E. Hall, Ltd.	2,645

Recommended. Electric lighting and power installations at Central Hospital (£116).—F. G. Edey & Co.

Accepted. Electrical installations at the Edgbury Convalescent Home (£458).—G. A. Weston.

Morecambe.—Electricity Committee. Accepted. Five transformers (£740).—Electric Construction Co.

Street Lighting Committee. Recommended. Electric tower wagon (£386).—Partridge, Wilson & Co.

Salford.—Light, Heat and Power Committee. Accepted. Supplies during the period from April 1st, 1936, to March 31st, 1937: Meters.—Ferranti; Met.-Vick.; B.I. Cables; Thompson & Co.; British Electric Meters. Transformers.—Hackbridge Electrical Construction Co.; British Electric Transformer Co. Switch units.—Met.-Vick.; Reyrolle. Sub-station switchgear.—English Electric Co.; Met.-Vick. Cable tiles.—H. J. Baldwin & Co. Joint box compound.—Dussek Bitumen & Taroleum; Berry, Wiggins & Co. Meter boards and battens.—Caxton Wood Turnery. Electric wash-boilers.—S. Simister & Co. Electric fires.—Falkirk Iron Co. Cookers.—British National Electrics; Walker, Hunter & Co. Hot-water circulators.—Johnson & Phillips; Archibald Low Electrics. Immersion heaters.—Archibald Low Electrics. Thermal storage heaters.—Santon, Ltd.; Simplex Electric Co. Switch fuses.—G.E.C.; S. Bill & Co. Switches and splitters.—S. Bill & Co. Electric motors.—Crompton Parkinson; Laurence Scott & Electromotors. Starters for motors.—Allen, West & Co.; Erskine Heap & Co.; G. Ellison.

Purchasing Committee. Accepted. Supplies during the year ending March 31st, 1937: Cables.—Mersey Cable Works; Ward & Goldstone; Greengate & Irwell Rubber Co. Tape.—Henley's; Connolly's (Blackley); Hamnet & Andrew; L. Andrew & Co. Fuse wire.—F. Smith & Co.

Seaham Harbour.—Electricity Committee. Accepted for twelve months: Meters.—Met.-Vick. Co.; Siemens Electric Lamps and Supplies. Meter boards and corner brackets.—T. J. Grainger & Co. Cut-outs and underground service boxes.—Henley's; Siemens Electric Lamps and Supplies. Ceiling roses, lampholders, tumbler switches, and d.p. switch fuses.—J. L. Miller & Co. Plugs and reel insulators.—British Elecl. and Mfg. Co. Cable and flex.—Ediswan. Switchgear for Vane Tempest sub-station (£421).—Crompton Parkinson.

Sheffield.—Electricity Committee. Accepted. Transformers: Met.-Vick Co. (£12,600); Hackbridge Elecl. Const. Co. (£14,808); British Elecl. Transformer Co. (£6,079); Brush Elecl. Engg. Co. (£2,419). Sub-station switchgear (£8,651).—A. Reyrolle & Co.

Forthcoming Events

Institution of Electrical Engineers.—Monday, April 6th. Institution, London, W.C.2. 7 p.m. Informal meeting. Discussion on "That the Electric Supply Industry Should Sell Service." To be opened by Mr. N. F. T. Saunders.

Meter and Instrument Section.—Friday, April 3rd. Institution, London. 7 p.m. "Capacitor Voltage Transformers." Messrs. J. G. Wellings, J. R. Mortlock and P. Mathews. "A Thyratron Stroboscope." Mr. R. S. J. Spilsbury.

Mersey and North Wales (Liverpool) Centre.—Monday, April 6th. The University, Liverpool. 7 p.m. Annual general meeting. Short papers will be read and discussed.

South Midland Centre.—Monday, April 6th. James Watt Memorial Institute, Birmingham. 7 p.m. Annual general meeting. "Private Plants and Public Supply Tariffs." Mr. J. A. Sumner. "Loss of Revenue on Heating and Lighting Loads, due to Poor Regulation." Mr. F. S. Naylor.

North-Western Centre.—Tuesday, April 7th. Midland Hotel, Manchester. 6.45 for 7.15 p.m. Annual dinner.

Scottish Centre.—Tuesday, April 7th. 39, Elmbank Crescent, Glasgow, C.2. 7.30 p.m. Annual general meeting. "Cineradiography." Mr. R. J. Reynolds.

Hampshire Sub-Centre.—Wednesday, April 8th. Municipal College, Portsmouth. 7.30 p.m. Short papers will be read and discussed.

Electrical Industries Benevolent Association.—Friday, April 3rd. Savoy Hotel, London, W.C.2. Noon. Annual general meeting. 1 p.m. Luncheon.

Institute of Transport.—Friday, April 3rd. Connaught Rooms, London, W.C.2. Annual dinner.

Physical Society.—Friday, April 3rd. Imperial College of Science and Technology, London, S.W.7. 5 p.m. Short papers will be read.

Royal Institution.—Friday, April 3rd. Institution, London, W.1. "The Electric Arc and its Applications." Lord Rutherford.

Electrical Power Engineers' Association (*Northern Division*)—Saturday, April 4th. Midland Hotel, Manchester. 5.30 for 6 p.m. Dinner.

Association of Mining Electrical Engineers.—Tuesday, April 7th. Junior Institution of Engineers, London, S.W.1. 6.30 p.m. "Some Notes on Motor Control Gear." Mr. J. R. Walton.

Illuminating Engineering Society.—Tuesday, April 7th. Institution of Mechanical Engineers, London, S.W.1. 7 p.m. Papers on the Photo-Electric Cell, by Messrs. R. C. Walker, L. H. McDermott and W. H. B. Hall.

Institution of Engineers-in-Charge.—Wednesday, April 8th. St. Bride Institute, London, E.C.4. "Corrosion and Modern Methods of Preventing Same." Mr. N. Swindin.

Notes

E.P.E.A. Dinners

The annual dinner of the Electrical Power Engineers' Association (Midland Division, Birmingham Section) was held at the Edgbaston Assembly Rooms, Birmingham, on March 27th last, Mr. A. E. Farmer (chairman) presiding. Alderman Sir Percival Bower (chairman, Birmingham Electric Supply Committee), in proposing the toast of the Association, considered that a 40-hour week would have to be introduced into industry. He stated that the employers' side of the negotiating committee in the electrical industry, representing not only municipal undertakings but power company undertakings, had been asked by the Ministry of Labour to consider the question of the application of a 42- or a 40-hour week to the electricity industry, to advise him on how it would affect further employment on the technical and manual sides, and how a shortened week could be applied without recourse to an increase in the price of electricity. He felt, however, that it would be impossible to apply a 40-hour week to one section of industry only. Sir Percival said that the policy of the Association was conciliation; he was satisfied that more could be obtained for the members by persuasion than by the use of the bludgeon.

Mr. J. F. Sarvent (president of the Association), in replying to the toast, said that each member of the industry could, by helping towards the success of his own particular undertaking, contribute towards the success of the national scheme. Mr. Farmer proposed the health of the guests, and Mr. E. Morgan (managing director, S.W.S. Electric Power Co.) responded. A dance followed the dinner.

The annual dinner and reunion of the London Western section of the Electrical Power Engineers' Association was held last Saturday at St. Ermin's, Westminster, Mr. W. J. Oswald presiding. Following the loyal toast Mr. H. W. Healy proposed that of "The Association." He mentioned the work done in the early days by Mr Lunn, one of the principal guests, and spoke of the status which electrical engineers had achieved through the Association. The president, Mr. J. F. Sarvent, also referred to the Association's activities. Mr. Arden, vice-chairman of the Section, proposed the toast of "Our Section and Our Chairman," to which Mr. Oswald responded.

Electrical Society of Glasgow

The annual dinner of this Society was held at the Grand Hotel, Glasgow, on March 26th. The toast of the Society was proposed by Mr. W. McFarlane, of the Central Electricity Board. In reply Mr. W. S. Campbell, the president, complained that Scotland did not appreciate the value of good electrical engineers and would not pay them well enough. If they wanted to improve their position financially it was necessary for them to go south of the Border.

E.I.B.A. (South Coast Branch)

The South Coast Branch of the Electrical Industries Benevolent Association is holding its third dance on April 17th at the Grand Hotel, Brighton. The last two dances have resulted in nearly £50 being sent to the funds of the Benevolent Association.

Qualifications for E.A.W. Diploma

At a recent meeting of the Training and Diploma Committee of the Electrical Association for Women, conditions for application for the diploma were revised. It was decided that the minimum age of applicants should be twenty-one, and that the period of service in the electrical industry should be at least four years, of which two must have included work of a responsible nature as a demonstrator or saleswoman.

Over fifty members attended the first annual luncheon and annual meeting of the Sheffield and District Branch on March 26th. Miss D. Foster Jeffery (area organiser, North-West England), Miss Kaye (area organiser, Mid-East England), and Mr. J. R. Struthers (city electrical engineer) were among the speakers.

Appointments Vacant

Meter repairer for Gainsborough Electricity Department.

Chief assistant engineer for Battersea Electricity Department.

Mains foreman for Watford Electricity Department.

Mains superintendent, mains assistant, junior mains assistant, senior and junior showroom assistants, stores clerk, foreman and four junior clerks for Bethnal Green Electricity Department.

Canvasser for Reading Electricity Department.

Assistant shift engineer for Hull Electricity Department.

Additional appointments for radio research in the Air Ministry Scientific Research Pool.

Charge engineer for Croydon Electricity Department.

Engineering draughtsman for Hackney Electricity Department.

Assistant construction engineer for Belfast Electricity Department.

Inspector of machinery for the Government of the Federated Malay States.

(See our classified advertisements.)

Our Personal Column

Electrical men are invited to keep readers of the "Electrical Review" posted concerning their movements

Mr. H. Fildes has rejoined the Hotpoint Electric Appliance Co., Ltd., as sales engineer of the Cooking and Heating Department, "Hotpoint House," Corporation Street, Manchester. Mr. Fildes, who received his technical training at the Municipal College of Technology, Manchester, was previously engaged with the company in Manchester as cooker sales engineer, and left in 1932 to take up an appointment as special representative for the Carron Company in the Midlands and North of England. From 1913 to 1923 he was manager in Ireland for the Metropolitan-Vickers Electrical Co. (formerly the British Westinghouse Electric & Manufacturing Co.), and district manager of the Metro-Vick Supplies Co. at Manchester from 1923-1927. At this time he became specialist sales engineer for the North of England and Scotland on the development of domestic appliances, cooking and boiling-plate business. While in Ireland he was hon. secretary of the Belfast Association of Engineers.

Mr. H. Fildes

Mr. Alan Maughan, of the Liverpool Electric Cable Co., Ltd., has been elected Federal President of the Australian Association of British Manufacturers, and also chairman of the New South Wales State Council for the year 1936.

Mr. R. H. Rawll, M.I.E.E., A.M.I.Mech.E., frequency change engineer, Birmingham Corporation Electric Supply Department, has been appointed sales and development engineer, being directly responsible to the chief engineer and manager for the commercial development of the undertaking.

At a meeting of the Kingston-on-Thames Town Council on March 25th **Mr. T. A. Kingham,** the borough electrical engineer, was asked to resign. This was the sequel to an investigation by the District Auditor into the accounts of the Electricity Department and a report by Mr. C. S. Davidson, borough electrical engineer of Barnes, who was appointed in a consultative capacity in January. At the Council meeting some members pressed for a public inquiry into the matter, but a motion to give effect to this was rejected and the Electricity Committee's report was approved by twenty-four votes to three.

The wedding took place on March 26th at Penang between Mr. K. J. Cassy and Miss Peggy Crowther, younger daughter of Mr. J. P. Crowther, M.I.E.E., of the Yorkshire Electric Power Co. Mr. Crowther is now at Doncaster and was formerly chief electrical engineer at Worksop.

Mr. P. M. Edinborough has recently been appointed manager of Elexcel, Ltd., whose Victor Works is described elsewhere in this issue. Mr. Edinborough has had a wide experience in the electric domestic appliance industry, having commenced twenty-four years ago with the British Prometheus Co. After holding positions with various other companies, he was appointed manager of the Domestic Appliance Department of the Edison Swan Electric Co., Ltd., in 1930, a position which he held until 1932, when he took up the appointment as commercial manager at the "Xcel" appliance factory of the Automatic Electric Co., Ltd. As manager of the new company he controls, under the board, all departments of the Victor electrical appliance works, including technical, design, production and marketing.

Mr. P. M. Edinborough

Mr. R. M. Hills, a director of Messrs. Gittings & Hills, Ltd., has retired after fifty-five years' service with the company, and at a dinner and dance recently given in his honour a presentation was made to him by Mr. J. J. Gittings, governing director.

Mr. P. Richardson, of Messrs. C. A. Parsons & Co., Ltd., has been nominated chairman of the North Eastern Student's Section of the Institution of Electrical Engineers for the session 1936-37.

Mr. Arthur Smith has joined Messrs. Johnson & Phillips, Ltd., as additional water heating sales engineer. Mr. Smith, who has made a special study of water heating, commenced his career as technical assistant to the Engineering Standards Committee. Later he joined the staff of Messrs. George Nobbs, Ltd., and was subsequently a member of the staff of the Water Heating Department of the Hotpoint Electric Appliance Co., Ltd.

Mr. Arthur Smith

Mr. W. J. John, B.Sc. (Eng.), A. R. C. S., M.I.E.E., has had conferred on him by the Senate of the London University the title of Reader in Electrical Engineering in the University, in respect of the post held by him at Queen Mary College.

Mr. A. P. Pearce, combustion engineer to the County of London Electric Supply Co., Ltd., has been appointed boiler house superintendent to the Hackney Borough Council Electricity Department in succession to Mr. P. Scott, who, as we have already reported, has been appointed boiler house superintendent to the Fulham Borough Council.

Mr. A. E. Franklin, J.P., the chairman of the Notting Hill Electric Lighting Co., Ltd., announced at the company's annual meeting last week that that would be the last occasion on which he would address the shareholders as chairman.

Obituary

Mr. A. R. Conway.—We regret to record the death of Mr. A. R. Conway, manager of the Assembly Department of Salford Electrical Instruments, Ltd., which occurred on March 23rd. Mr. Conway, who was fifty-two years of age, served his apprenticeship at the old G.E.C. works at Salford, and later took up the position of foreman in the Instrument Department of Messrs. Ferranti, Ltd. From there he went to Messrs. Runbaken, where he was manager for many years. He re-entered the service of Salford Instruments, Ltd., in May last year.

Mr. G. W. Williams, a director and sales and advertising manager of the British Vacuum Cleaner & Engineering Co., Ltd., died on Monday last after an illness of about three months. He had been with the company since 1903.

Sir Joseph Petavel, D.Sc., F.R.S., Director of the National Physical Laboratory, died on March 31st, at Bushy House, Teddington, at the age of sixty-two. Sir Joseph received his early scientific training at University College, London, under Sir J. A. Fleming, and at the age of thirty-five was appointed Professor of Engineering and Director of the Whitworth Laboratories in the University of Manchester, where he carried out the work on the attainment of very high pressures, which formed his most original contribution to physical science. On the formation of the Advisory Committee on Aeronautics in 1909, he became a member, and was appointed chairman of the Aerodynamics Subcommittee in 1917. He was a member of the General Board of the National Physical Laboratory from 1911 to 1916, and in 1919 succeeded the late Sir Richard Glazebrook as Director. Sir Joseph served on numerous Government and other committees. He was for several years chairman of the Engineering Co-ordinating Research Board of the Department of Scientific and Industrial Research and was a member of the Radio Research Board. He also served on the Councils of the British Electrical and Allied Industries Research Association and of the British Standards Institution, and was a past-president of the Engineering Section of the British Association. He was created a K.B.E. in 1920.

The late Sir Joseph Petavel

Financial Section

New Companies. Official Returns of Capital. Debenture Charges. Reports of Electrical Companies. Dividend Announcements. Transactions in Stocks and Shares

New Companies Registered

Controller Contacts (Cardiff), Ltd.—Private company. Registered March 26th. Capital, £1,000 in £1 shares. Objects: To acquire the manufacturing portion of the business of Paxtons (Cardiff), Ltd., carried on by them at Regal Works, Whitchurch Road, Cardiff; to adopt an agreement with H. W. C. Hinchley; and to carry on the business of electricians, mechanical and motor engineers, &c. The first directors are: H. W. C. Hinchley and Mrs. E. M. Hinchley, both of Whitchurch Road, Cardiff. Solicitors: Buchanan, Giles & Evans, 5, Edward Terrace, Cardiff.

R. S. Newton, Ltd.—Private company. Registered March 21st. Capital, £2,000 in £1 shares. Objects: To acquire the business of an electrical engineer, electrical and hardware factor, &c., carried on by Robt. S. Newton at 41, Fountain Street, Manchester, as "R. S. Newton & Co." The permanent directors are: R. S. Newton (chairman), electrical engineer, and Mrs. E. J. Newton, both of Oak Haven, Moss Lane, Bramhall, Ches.

Tom Phillips, Ltd.—Private company. Registered March 23rd. Capital, £500 in £1 shares. Objects: To acquire the business of a general electrical engineer and contractor and wireless and gramophone dealer carried on by T. J. Phillips at 57, Station Road, Port Talbot. The directors are: T. J. Phillips and Mrs. K. Phillips, both of 57, Station Road, Port Talbot. Solicitor: D. Harold Jones, 127, Station Road, Port Talbot.

Francis Tube-Lights, Ltd.—Private company. Registered March 23rd. Capital, £2,200 in 4,000 ordinary shares of 1s. each and 2,000 7½ participating preference shares of £1 each. Objects: To carry on the business of manufacturers of and dealers in electric signs of all kinds, &c. The directors are: L. F. Mitchell and S. A. Mitchell, both of 209, Isledon Road, London, N.7.

Haynes Radio, Ltd.—Private company. Registered March 25th. Capital, £1,000 in £1 shares. Objects: To acquire the business of a radio manufacturer and electrical engineer now carried on at 40, Queensway, Enfield, by Fdk. H. Haynes as "Haynes Radio." The directors are: F. H. Haynes and E. L. Haynes, both of 38, Sittingbourne Avenue, Enfield. Registered office: 40, Queensway, Enfield, Middlesex.

Paragon Electric Cleaners, Ltd.—Private company. Registered March 21st. Capital, £4,000 in £1 shares (2,000 6 per cent. cumulative preference). Objects: To carry on the business of manufacturers, importers, repairers and distributors of and dealers in electric cleaners of all kinds. The directors are: A. W. Curtis (chairman) and three others. Secretary: A. E. Billing. Registered office: Paragon House, 219, Isledon Road, Finsbury Park, N.7.

Intex Engineering Co., Ltd.—Private company. Registered March 27th. Capital, £1,000. Objects: To carry on the business of manufacturers of and dealers in apparatus used in connection with the generation and distribution of electricity, &c. The directors are: G. Oliven and G. Mainzer, of 15, Dartmouth Street, London, S.W.1. Solicitors: Last Riches & Fitton, 18, Bolton Street, London, W.1.

Phœnix Battery Co., Ltd.—Private company. Registered March 27th. Capital, £500. Objects: To carry on the business of battery manufacturers, &c. The permanent directors are: T. G. Miller, 60, Brecon Road, Fulham, S.W.6, and R. J. Woolner, 106, Warden Avenue, Harrow. Registered office: Roslyn Works, Roslyn Road, South Tottenham, N.

Electric Service (Exeter), Ltd.—Private company. Registered March 28th. Capital, £600. Objects: To carry on the business of electrical engineers, electrical contractors, &c. The directors are: H. J. Cornish, 2, Grove Terrace, Crediton, Devon, and G. A. King, Long Range, Whimple, Devon. Secretary: L. G. Burrows. Registered office: "Tacana," Regents Park Road, Exeter.

Grundy & Partners, Ltd.—Private company. Registered March 28th. Capital, £300. Objects: To carry on the business of electrical engineers and contractors, &c. The directors are: R. A. Grundy, 11, Links View Road, Hampton Hill, Middlesex, and three others. Registered office: 11, Links View Road, Hampton Hill, Middlesex.

R. & C. Industries, Ltd.—Private company. Registered March 21st. Capital, £3,150 in 3,000 7½ per cent. cumulative preference shares of £1 and 3,000 ordinary shares of 1s. each. Objects: To carry on business as electrical, general and mechanical engineers, manufacturers of and dealers in electrical, mechanical and optical instruments, &c. The subscribers are: A. Sivalla, 215, Cannon Hill Lane, W. Wimbledon, S.W.20, and R. Gardner, 99, Portsdown Road, W.9. Secretary: T. Auker.

Returns of Electrical Companies

Brentwood District Electric Installations, Ltd.—Satisfaction in full on November 30th, 1935, of mortgage dated October 15th, 1930, and registered October 17th, 1930. Notice filed March 18th, 1936. (According to the register of mortgages, the mortgage registered October 17th, 1930, originally secured £4,500.)

British G.W.Z. Battery Co., Ltd.—Satisfaction in full on March 18th, 1936, of debentures dated March 22nd, 1933, and registered March 24th, 1933, securing £5,000.

Beck & Moss, Ltd.—Satisfaction to the extent of £1,250 on March 11th, 1936, of trust deed dated April 23rd, 1902, and registered May 2nd, 1902.

Automatic Electrical & Mechanical Controls, Ltd.—Particulars filed of £1,000 debentures, authorised March 6th, 1936, charged on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being £200.

Brush Electrical Engineering Co., Ltd.—Debenture dated March 3rd, 1936, to secure £40,000 charged on freehold and leasehold properties comprised in trust deed dated September 4th, 1908, and subject thereto freehold properties at Loughborough, certain stock and shares, and a floating charge on the company's undertaking and other property, present and future, including uncalled capital (subject to earlier deeds). Holders: Westminster Bank, Ltd.

Amalgamated Battery Co., Ltd.—Mortgage debenture, dated March 9th, 1936, to secure £1,400, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: H. G. N. Lee, 24, John Street, Bedford Row, London, W.C.

Quartz Crystal Co., Ltd.—Particulars filed of £500 debentures authorised February 28th, 1926, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Collins & Scott, Ltd.—Particulars filed of £300 debentures, authorised March 9th, 1936, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Bursiem's Patents, Ltd.—H. A. Snelling, of Columbia House, Aldwych, London, W.C.2, was appointed receiver on March 19th, 1936, under powers contained in debentures created November 20th, 1935, and January 2nd, 1936.

Invicta Electrodes, Ltd.—The nominal capital has been increased by the addition of £5,000 in £1 ordinary shares beyond the registered capital of £5,000.

Universal Lamp Co., Ltd.—Capital, £12,500 in £1 shares. Return dated September 14th, 1935 (filed March 9th, 1936). 12,500 shares taken up. £2,500 paid, £10,000 considered as paid. Mortgages and charges, nil.

Formo Products, Ltd.—Capital, £1,000 in £1 shares. Return dated December 13th, 1935. 350 shares taken up. £350 paid. Mortgages and charges, nil.

W. J. Burroughes & Sons, Ltd.—H. A. Esden, of 6, Bishopsgate, E.C., was appointed receiver and manager on March 19th, 1936, under powers contained in debentures dated March 7th, and May 2nd, 1934.

Sciaky Electric Welding Machines, Ltd.—Capital, £15,850 in 15,000 preference shares of £1 and 17,000 ordinary shares of 1s. Return dated December 31st, 1935. 8,000 preference and 17,000 ordinary shares taken up. £8,000 paid on the preference shares. £850 considered as paid on the ordinary shares. Mortgages and charges, nil.

British Electric Hydrators, Ltd.—J. J. Jubb, of Albert Buildings, 151-7, Fitzwilliam Street, Sheffield, was appointed receiver on March 19th, 1936, under powers contained in "B" mortgage debentures dated December 31st, 1935.

City Notes

British Insulated Cables, Ltd., held its annual meeting on Tuesday last at Liverpool, Sir Alexander Roger (chairman) presiding. In presenting the report and accounts the chairman said that the results of the year's working were again satisfactory in almost every respect, the profits being increased by £113,831, due partly to substantial economies effected in the cost of manufacture and partly to the increased turnover. Referring to their connection with the Automatic Electric Co., of which the holding company was the International Automatic Telephone Co., he said that they were able last year to acquire the share capital remaining in American hands. The shares were the "A" deferred shares of the International Automatic Telephone Co., which carried 50 per cent. of the votes of that company. An all-British group with combined assets of approximately £12,000,000 had been thus established in the electrical and communications world, embracing cable manufacturing and network construction, telephone operating and finance. They pursued the policy of widening the base of their business in every direction cognate to the transmission of electrical energy, and they continued to collaborate with other companies in the industry in the many technical developments, which showed signs of becoming more numerous. They had recently taken an active interest and had invested considerable capital in a company which was financing the wiring of domestic premises on the hire-purchase system. It had made a good start and they were getting a share of the orders for cables and wires required for the purpose. During the past few years they had spent considerable time and money in the design and development of a system for transmitting wireless broadcast programmes over the ordinary lighting and power cables. By the courtesy of the Liverpool Corporation it had been demonstrated that five or more wireless programmes could be received by plugging in a simple apparatus to any ordinary electric light socket. A Government Committee had recommended that the responsibility for the whole of the relay wireless service in this country should be handed over to the Post Office. If this recommendation was accepted by Parliament they would put the results of their experiments at the disposal of the B.B.C. and the Post Office. The result of the working of British Copper Refiners, Ltd., continued to justify their enterprise in that undertaking, and they were adding to the capacity and scope of the refinery so as to be able to meet the requirements of buyers outside the cable industry. It was gratifying that recently an impetus had been given to railway electrification with Government help, and they were hopeful that they might be awarded a share in this development. Their foreign business remained reasonably good and showed signs of expansion. They had at present two considerable contracts in connection with railway electrification in course of construction, one in Brazil and the other in Poland. These contracts were being carried out in conjunction with the Metropolitan-Vickers Co., their portion consisting of the supply and erection of overhead track equipment. In many departments last year their output eclipsed previous records. Nearly 100,000 tons of manufactures

were dispatched, ranging from the heaviest of cable work down to a length of enamelled winding wire sufficient to girdle the earth at the equator more than 125 times. The prospects for the immediate future remained good. Their order book so far showed an improvement on last year, and practically all the manufacturing departments were working to capacity.

The British Thomson-Houston Co., Ltd., held its annual meeting on March 26th, when Mr. W. C. Lusk (chairman), who presided, said that the improvement in general business conditions continued throughout 1935, and the volume of orders received and shipments from their factories were in excess of those for the previous year. Unexecuted orders on hand at the end of the year were greater than at the end of 1934, and these conditions had resulted in an increase in the number of their employés. Many important orders were received for central station plant, sub-station plant and heavy industrial applications, such as rolling mills and mine winding equipments. These included a large number of mercury-arc rectifiers for the South African Electricity Supply Commission for converting a 90,000-V, 3-phase a.c. supply to 3,000 V d.c. for the electrified railways and also for converting and putting back into the 90,000-V a.c. system the 3,000-V d.c. power generated by the electric locomotives when descending grades and braking. All the electricity on the *Queen Mary* was produced by B.T.H. generators, and a substantial portion of the energy was used in motors, lamps and other devices made by them and by companies associated with them. Research work continued to be actively carried on in the laboratories at Rugby, both original research with the object of finding new products and processes and also research in connection with their existing products. At the last meeting he referred to extensions at the Coventry works to deal with aircraft equipment. While the volume of this work was not large as compared with their heavy engineering products, there was nothing which they made to which they attached more importance, and the quality and reputation of their aero magneto and other aircraft equipment had been maintained. Further research and development had been carried out during the year in connection with "Mazda" lamps for general lighting service and their electric discharge "Mercra" lamps for street and outdoor lighting. The increased demand for "Mazda" lamps had necessitated further substantial extensions to their lamp works at Rugby. In the street lighting field, the electric discharge lamp was making good headway, and they were hopeful of still more progress in this direction as a result of further development work now being carried out in the laboratories and those of other companies with whom they were collaborating in this work. Price levels generally for heavy engineering products were still too low, and, while the prospects of a continuation of good conditions of trade during 1936 appeared to be favourable, they were faced with costs of raw materials which had already increased to some extent and would probably rise further during the year. On July 1st last they put into effect a pension and insurance plan for the members of their staff.

The Midland Electric Corporation for Power Distribution, Ltd., held its annual meeting on Tuesday last at Liverpool, when Mr. G. H. Nisbett (chairman) said that the last annual meeting found them reorganising the whole system of administration following a record year. New distribution headquarters and a number of sub-stations were in course of erection, and large feeder mains were being laid, capital expenditure on works in progress being estimated at £200,000. The new organisation was completed and working smoothly, and the ring mains were completed in September and a portion used that month. The switching into full operation of the remaining sections took place in October. These 33,000-V mains were about 33½ miles in length. British Insulated Cables, Ltd., supplied, laid and jointed the cables; Ferguson, Pailin, Ltd., the switchgear; and Bruce Peebles & Co., Ltd., the transformers. In addition to this feeder system many miles of new mains were laid by the staff to carry electricity into new districts and to supplement supply in areas already served. During 1935, 7,822 new consumers and over 28,000 h.p. of additional demand were connected, while the sales of electricity increased by 17 per cent. The change-over from d.c. to a.c. in Wednesbury was completed. Of the additional load connected during the year 10,000 kW represented additions to the industrial load. Six installations of oil engines, totalling over 1,000 h.p., were displaced by electric drive, while they were still in negotiation for other oil-engine loads amounting to 1,700 h.p. The low charge for industrial power had made the application of electricity to furnace heating economically possible. Private plant could not compete with the company's charges under normal conditions, and they expected to continue replacing private generating plant by public electricity supply. During the year over 7,000 kW of new domestic load had been connected. There was a definite demand for electricity in small houses and they had met this by hire-purchase installations and hire-purchase of domestic electrical appliances. The electric-discharge lamp had created an increased demand for electric public lighting, and they had secured one contract, while tests were proceeding in four other districts. The average price per kWh sold in 1935 was 0.88d., as against 0.92d. in the previous year. In addition, consumers would receive a special rebate of 2 per cent. on their accounts for the first quarter of 1936. Since the 1933 Special Order came into force the company had more than doubled the whole of its activities. The increase in output for January and February, 1936, over the corresponding months of 1933 was over 90 per cent.

The International Automatic Telephone Co., Ltd.—Presiding at the annual meeting held on March 26th, Sir Alexander Roger (chairman) referred to the acquisition in 1934 of the "A" ordinary shares of the Telephone and General Trust, Ltd., and said that this had been followed in 1935 by successful negotiations in America resulting in the purchase by the British Insulated Cables, Ltd., of the "A" deferred shares of their company which carried 50 per cent. of the entire voting strength. Thus an all-British group, with combined assets of £12,000,000, had been established in the electrical and communication field. The order books of both the sales and manufacturing companies had been satisfactory during 1934, and the position had improved throughout the year under review, mainly due to the increased demand for telephone plant at home and overseas. Their export trade had penetrated forty-six countries. For many years the export market had been greater than that at home, but judging by the present rate of telephone expansion the home business would soon take the lead. Relationships with the Governments of South Africa, Poland, Lithuania and other telephone operating administrations continued to be satisfactory, and much work had been undertaken for the Union Government of South Africa, for whom they had recently completed the Johannesburg central automatic exchange and the telephone network of Durban, comprising twelve automatic exchanges. Dealing with their range of products, Sir Alexander said that many new installations of their "Electromatic" vehicle-actuated street traffic signals were opened for service during the year. In December last a subsidiary company (Elexcel, Ltd.) owned and controlled by the Automatic Electric Co., Ltd., had been formed to deal with the manufacture and sale of "Xcel" domestic electrical appliances. With regard to the Post Office, at the end of 1935 there were 2,500,000 telephones connected to their system and expansion was expected to continue at 200,000 stations per annum. It was announced last year that the Post Office had decided to continue with the "Strowger" line-finder system, and now they had adopted as standard the new "Strowger" switch.

The Shropshire, Worcestershire and Staffordshire Electric Power Co. held its annual meeting on March 30th, when Brig.-Gen. Wade H. Hayes (chairman) said that the area of the company's operations had been extended by the transfer to it of the undertaking under the Brecon Electricity Special Order, 1926. Since the close of the year the directors had acquired a small non-statutory undertaking in Brecon. The extensions to the boiler plant at the Stourport power station were progressing satisfactorily, and it was hoped that the new boilers would be in operation in the immediate future. The transmission and distribution systems had been extended during the year to provide supplies of electricity to a number of new districts, and they now had over 2,100 miles of lines. The number of consumers in 1935 increased by 15 per cent. over the number at the end of 1934. Their subsidiary companies were showing satisfactory progress and results, this being very pronounced in the case of the South Wales Electric Power Co., which was their largest subsidiary. Local authorities had certain rights under the Electricity (Supply) Acts for the acquisition of electricity undertakings within their local areas, and in many parts of the country the possible transfer of electricity undertakings from companies retarded comprehensive development programmes on progressive lines. It was hoped that, as an outcome of the deliberations of the Government Committee on Electricity Distribution, legislation would be enacted to provide the security of tenure which was essential before a proper development could be undertaken without undue risks to the large sums of capital required.

The Notting Hill Electric Lighting Co., Ltd., held its annual meeting on March 26th, when Mr. A. E. Franklin, J.P. (chairman), who presided, said that the average price charged per kWh was 2.36d. as compared with the standard rate of 3.065d., thus effecting a saving to the consumers, many of whom were now adopting the two-part tariff, of £43,000. With regard to the question of the arrangements with the Metropolitan Electric Supply Co., it was agreed that it would be inadvisable for their company to cease to function, but that some means should be found by which the control of the distribution should be unified so that the demand could be spread and the machinery and plant used more effectively. The principle adopted was that the holders of the ordinary shares should join the pool of the Metropolitan Co. and exchange their shares for shares in the holding company at a ratio which would give them the same income as they had before. The Notting Hill Co.'s contracts were to be honoured, its relations with its employés continued, and steps taken to bring the charges for electricity into line with those of Paddington.

The British Power & Light Corporation, Ltd., held its annual meeting on March 31st, when Mr. C. E. Benson (chairman), who presided, said that during the year under review they had carried out various internal re-arrangements of finances of all their subsidiary companies, with the exception of the North Wales Power Co., which they hoped to deal with within the next few months. As regarded the subsidiaries, they were still going ahead in the development of the North Wales Power Co. Perhaps the largest development in size was that with which they were proceeding in the Island of Anglesey. The part they were developing was a sparsely populated area, containing a number of small villages. They had completed the first stage of the development and now had before the Electricity Commissioners a scheme for the second stage. The water position during the year had been considerably more satisfactory, although somewhat below the normal, and they had been able to generate approximately 36 per cent. more energy. At the moment the water supply showed a storage equivalent to 10.3 million kWh, as compared with 14.6 million kWh at the same period last year. They had again allocated in the North Wales Power Co. £25,000 to a contingency reserve fund. They were installing an additional generating set at Dolgarrog, and they had under review and hoped to commence shortly an extension of the pipe line at that station. All their English companies were now firmly established. The report and accounts were adopted and a resolution was passed increasing the capital to £3,250,000 by the creation of 450,000 new ordinary shares of £1 each and offering to shareholders one new ordinary share at 25s. for every £5 of stock held.

The Clyde Valley Electrical Power Co. held its annual meeting on Tuesday last, when Mr. C. Ker (chairman), who presided, said that the Clyde's Mill extensions were begun in March, 1935, and the new 30,000-kW turbo-alternator was now in use, making the company's total plant capacity, including 15,520 kW from the Falls of Clyde, 147,520 kW. The next additions to plant were to be at Yoker. In the past year twenty-seven new cables were laid across the Clyde between Yoker and Renfrew and two submarine cables across the Gareloch

from Rhu Spit to Limekiln Point, supplying electricity to Roseneath, Clynder, Cove and Kilcreggan. Other rural areas to receive supplies were Douglas and Glespin. Since taking over the Coatbridge and Airdrie undertakings in October, 1934, forty miles of cables had been laid and a great deal of renewal work had been effected in that area, while the consumers had increased by 1,500 to 3,500. He said that the company had been working for three years under the Act of 1926, but only the accounts for the first year had been finally adjusted with the C.E.B., and it appeared evident from present negotiations concerning the final adjustment of accounts for the other two years, that they and their consumers would receive no benefit from operation under the Act.

The South London Electric Supply Corporation, Ltd.—Presiding at the annual meeting held on Tuesday last Lord Gainford (chairman), in explaining why the figures for 1935 appeared to be unsatisfactory compared with those for 1934, said that in late 1934 and early 1935 substantial reductions were made in charges to consumers to such an extent that in the year under review there had not been sufficient time to realise the anticipated expansion in sales which it was hoped would offset the lower prices. The number of consumers, however, had increased by 18 per cent. Lord Gainford, after reviewing the accounts, said that in the first two months of the current year there was an increase of 20 per cent. in sales as compared with the corresponding period of 1935. With regard to street lighting, the past year had seen the completion of the parapet lighting on the embankment south of the river between Westminster and Vauxhall bridges, and since then the contract had been obtained from the Lambeth Borough Council for lighting twenty-one miles of main roads by electric discharge lamps. The campaign for the installation of refrigerators on a hire-purchase system at 2s. 6d. per week had already created a heavy demand for this apparatus.

The Bournemouth and Poole Electricity Supply Co., Ltd.—At the annual general meeting held on Tuesday Sir Robert Renwick (vice-chairman), who presided, said that the past year had been somewhat unusual for the undertaking but, having got through a transitional and difficult period, they felt assured of the continued expansion and development of their sales. During the year the work of frequency standardisation had been completed, enabling the Bourne Valley generating station to be closed down, but the fact that they had had to operate the station and purchase electricity from the grid for half the year had affected their production costs. The supply area had been extended by the acquisition of the Milford-on-Sea Electric Supply Co.'s undertaking and by laying 158 more miles of distribution mains. For the first two months of this year the number of consumers connected showed an increase of 40 per cent. over the corresponding period of last year, and sales of electricity had risen 18 per cent. Electricity was now available in twenty-seven villages. A resolution was passed converting the ordinary shares into stock.

The Richmond (Surrey) Electric Light & Power Co., Ltd.—The opinion that two-part tariffs did not favour the small man and he was forced on to the alternative flat rate was refuted by Sir Robert Renwick (chairman) at the annual general meeting on Tuesday. It was a fact, he said, that the small man not only appreciated the two-part tariff but used it to the full, the average price for current paid by those consumers residing in small artisan dwellings and flats being only 0.895d. per kWh. To accelerate domestic consumption the company had put into force hire charges that gave greater facilities to consumers than could be found elsewhere. A contract had been obtained from the Corporation for the lighting of all the principal thoroughfares in the town by electric-discharge lamps. This installation was actually being completed this week and would provide illumination eight to eleven times greater than hitherto.

The British Aluminium Co., Ltd.—A discovery of a method whereby added advantage might be taken of the natural properties of aluminium with regard to the reflection of light and radiant heat was referred to by the chairman, Mr. R. W. Cooper, at the annual general meeting of the company on Tuesday. The new process enables the efficiency of the reflector to be maintained indefinitely and already two industrial plants have been installed for carrying out the process on a commercial scale. The Lochaber Works continue to realise expectations and the whole of the plant was worked to full capacity for the first time last year. The chairman denied a statement that the company saw no prospect of utilising the surplus water at Lochaber; all the reserves of water would, in fact, be required eventually to meet increased demands for aluminium, though possibly a restricted supply might be given for a limited period.

The English Electric Co., Ltd., reports a trading profit for the year ended December 31st last of £262,619, as compared with £172,215 in the preceding year. From this is deducted debenture interest (£60,185), fees (£2,860), depreciation paid to Willans & Robinson (£15,932). The net balance is £130,142. From the debit balance of £245,368 brought in is subtracted £137,689, surplus from the liquidation of Willans & Robinson, leaving £107,679. This, deducted from the net profit of £130,142, leaves a credit balance to be carried forward of £22,463. The assets of Willans & Robinson were taken over by the company. The report states that the improved demand for the company's products noted a year ago has been fully maintained, and a satisfactory share of the business has been secured by the company. Orders in hand enable the directors to look forward with confidence to the results for the current year. Meeting: April 6th.

Yesterday (Thursday) an offer for sale was made by Messrs. Lazard Bros. & Co., Ltd., of £1,250,000 of 4 per cent. debenture stock at £98 per cent. The purpose of the issue is primarily to enable the company to repay the 5½ per cent. sinking fund first mortgage debentures and the 6 per cent. debenture stock which the company has given notice to redeem on July 1st next. The balance of the proceeds of the issue will be used to meet capital and other expenditure necessitated by the growth of the company's business.

A. Reyrolle & Co., Ltd., report a profit for 1935, after providing for depreciation of buildings and plant, of £114,336, as compared with £103,303 in the preceding year, to which is added £115,858 brought forward, making £230,194. From this is deducted £1,000 voted at the last annual meeting for distribution among local charitable and other funds. It is proposed to maintain the ordinary dividend at 12½ per cent. for the year and to transfer to provision for development expenditure £30,000, leaving a balance of £118,893 to be carried forward. The profit and loss account includes £10,400 dividend on the company's holding in Parolle Electrical Plant Co., Ltd. The report states that the value of orders received was greater than in the previous year, and there was a considerable increase in the amount of uncompleted work in hand. The demand for the company's manufactures continues to be satisfactory.

The Cambridge Electric Supply Co., Ltd., reports a net profit for 1935 of £48,652. It is proposed to place £10,160 to reserve, and to pay a final ordinary dividend of 3½ per cent., making 6 per cent. for the year and leaving £8,492 to be carried forward. An agreement whereby the Corporation is to forgo its rights to purchase the 1890 Order undertaking and the company is to make certain reductions in its charges for electricity, operates as from April 1st.

The Anglo-Portuguese Telephone Co., Ltd., reports a net profit for 1935 of £84,634, as compared with £79,412 in the preceding year. To this is added £23,258 brought in, making £107,892, and it is proposed to pay final dividends of 5 per cent. on the ordinary shares, making 8 per cent. for the year, and 8 per cent. for the year on the "A" ordinary shares. A sum of £20,814 is transferred to reserve for renewals and £25,698 is carried forward. Meeting: To-day (Friday).

The Singapore Traction Co., Ltd.—Unanimous approval was given at an extraordinary general meeting held on Tuesday to a scheme put forward whereby preference shareholders agreed to the cancellation of dividend arrears amounting to 22 per cent. in consideration of the allotment of one new fully paid preference share in respect of each £8 of preference stock held.

The Tamworth District Electric Supply Co., Ltd., reports a net profit for 1935 of £10,896, which with £1,887 brought in makes £12,783 available. The final ordinary dividend is 4½ per cent., making 7 per cent. for the year, and £2,783 is carried forward. In October last the nominal capital was increased by the creation of £50,000 4 per cent. participating preference shares, of which £25,000 was issued.

The Cambridge Instrument Co., Ltd., proposes to sub-divide its existing £5 preference and ordinary shares into five preference and ordinary shares of £1 each respectively and to increase the capital to £240,000 by the creation of 45,000 new shares of £1 each. Part of the new shares are to be issued to shareholders in the ratio of one new share for every £4 of ordinary shares held.

The Edison Swan Electric Co., Ltd., held its annual meeting on March 26th, when Mr. C. F. Spencer (chairman), who presided, after reviewing the accounts for 1935, said that during the current year to date trading had been satisfactory, but with increasing competition it was difficult to see how it would be possible to maintain the same ratio of profit to turnover as that which prevailed in 1935.

International Combustion, Ltd., published on Tuesday last particulars of the constitution and objects of the company in compliance with the Regulations of the Committee of the Stock Exchange.

The Marconi International Marine Communication Co., Ltd., proposes to pay a final dividend of 5 per cent., making 7½ per cent. for 1935 (same).

Joseph Lucas, Ltd., are again paying an interim ordinary dividend of 2½ per cent., lass tax.

Stocks and Shares

TUESDAY EVENING.

STOCK EXCHANGE markets have fallen into a jog-trot of somewhat uninteresting conditions, owing to a subsidence of political anxieties, although, at the same time, there remains a very present feeling of uncertainty as to what may happen next. Instead of bringing in sellers from Paris, as expected, the issue of the German election appeared to allay a certain amount of nervousness on the Continent and to encourage the return of capital to this country. This movement has been accelerated by fresh rumours of devaluation of the franc, though such a possibility has been once more denounced by the French Minister of Finance.

The industrial section of the Stock Exchange is characterised by few special features, but amongst the latter are to be noted rises in shares of various electrical construction and manufacturing companies. The general run of prices is somewhat irregular. Business is noticeably less than that with which Stock Exchange markets were called upon to deal earlier in the year.

The Stock Exchange Year

Circumstances have, unfortunately, conspired to mar the close of an otherwise decidedly satisfactory Stock Exchange year. Up to the time of the German Chancellor's sudden action in the Rhineland Stock Exchange business had been broadening and flourishing in an atmosphere of confidence inspired by the evidence of a genuine recovery in practically every branch of industry in this country. The year has been one of rising prices, higher trading profits and increased dividends. Now the feeling of confidence and security has been disturbed, and the Stock Exchange new financial year starts in a fog of international dimensions. Investment, unable to see more than a few days ahead, inevitably stays its hand; the speculator is concerned with keeping his position

open and his resources liquid. Substantial amounts of money are being held back from the Stock Exchange markets. Success of the negotiations at present in progress between the European nations would quickly bring about release of capital and a return to more normal conditions in financial circles.

Electricity Supply Shares

The dividend season in the market for electricity supply companies' shares being for the most part over, practically the only factor likely to bring a spark of animation to the market in these uncertain days has been removed. Business is almost at a standstill, and, apart from slight shrinkages in North-Easterns and South Londons, our weekly list of prices is virtually unaltered. Foreign supply companies' shares are a little more interesting. Palestine "A" shares improved to 52s. 3d. and Perak Hydros to 24s. Tokyo "sixes" declined 3 points to 84. East African ordinary are rather better at 33s. bid.

A.E.I. and English Electric

Associated Electricals became a firm market after publication of the full report and accounts. The raising of the dividend from 6 per cent. to 8 per cent. was announced previously. The ordinary shares hardened 1s. 6d. to 46s. 6d., and the preference 6d. to 38s. 6d. The jump in the company's profits for last year is well up to expectations, due allowance being made for the fact that the premium, amounting to over £100,000, on the redemption of the whole of the 4 per cent. debenture stock was provided for during the year. The resultant saving in interest is only partially reflected in the accounts. The company is clearly receiving its full share of the prosperity of the electrical equipment industry, and the healthy state of the British Thomson-Houston Company, as disclosed at the annual meeting, provides additional grist for the A.E.I. mill.

English Electric shares, particularly the preference, came in for support when the results of last year's trading became known. Assisted by the proceeds of the liquidation of a subsidiary, profits have sufficiently recovered to eliminate the debit carried forward since the unprofitable year of 1933. The current year's earnings will therefore be available for distribution to shareholders. There is lively discussion in the market on the question of the resumption of dividends. It is pointed out in the report that last year's net profit of £130,000 would have been sufficient to cover the payment of the 6½ per cent. preference dividend and provide, in addition, a 4 per cent. dividend on the ordinary shares. The preference shares have appreciated 2s. to 24s. 6d. on the belief that next year's accounts will show profits to be within sight of the £220,000 or so required to satisfy the three years' arrears of dividend, which, by then, will have accumulated. The ordinary shares have firmed up to £1. In order to allow a payment on the ordinary capital next year, profits will need to be more than doubled. The dividend outlook is, therefore, necessarily regarded as obscure at the present time. The company is taking steps which will result in a saving of interest on the outstanding debentures.

Other Electrical Equipment Shares

The wet blanket of European politics is too heavy to permit enthusiasm which might otherwise be aroused in the market for electrical equipment companies' shares by reason of the accumulating evidence of prosperity in the industry. The market, however, refuses to be flurried by surrounding uncertainties, and prices tend to improve. Enfield Cables are quoted at 5, the equivalent of the share bonus having been deducted from the price. Enfield Rolling Mills are again lower at 25s. 6d. Callenders and British Insulated show strength, the former being up ¼ at 4½, and the latter ⅜ at 5 3/16. Henleys, on the other hand, fell ½ to 7½. Johnson & Phillips are a little better at 46s. 9d. British Aluminiums slipped back about 2s. to 41s. 6d. ex dividend. Although the accounts show a good expansion of profits, there remains some disappointment that the dividend was no more than maintained. The Reyrolle profits statement was followed by a drop to 66s. 9d. ex dividend. General Electrics are a few pence lower on the week, and Cromptons lost 2s. 6d. to 62s. 6d. Other price changes are generally insignificant.

Miscellaneous Matters

Transatlantic markets remain subdued by reason of the critical state of affairs in Europe and the disastrous floods in the North-Eastern States of America. American "Tel. and Tel.," however, recovered 3 points of the heavy fall which followed the announcement of restrictions in alien ownership of the stock. International "Tel. and Tel" are a shade lower at 16¾. Radio Corporations lost ⅜ to 12⅜, and Western Unions 2½ to 85½. Canadian Marconis are no better at 8s. 6d. Brazilian securities are dull, on account of a possible renewal of internal dissensions. "Tractions" receded to 12⅜, and Hydros ⅛ to 8.

Wireless and gramophone issues present few features. McMichaels went further ahead to 3s. 3d. Electric and Musical Industries and Pye deferred were firm. E. K. Coles lost 6d. to 24s. British Vacuum Cleaners at 32s., Vactrics at 22s. 6d., and Revo Electrics at 39s. are each about 6d. down. Broadcast Relay Services picked up to 7s. 9d. after their slump to 6s. 6d. on publication of the Ullswater Report, against whose recommendations the company is protesting.

Share List of Electrical Companies

	Nom.	Dividend. 1933.	Dividend. 1934.	Price Mar. 31.	Rise or Fall.	Yield p.c. £ s. d.
Home Electricity Companies.						
Bournemouth and Poole	1	15	15	3 11/16	—	3 18 8
City of London	1	7½	7½	37/6	—	4 0 0
Clyde Valley	1	7	8	44/6	—	3 12 0
County of London	1	10½	10½	57/–	—	3 13 8
Edmundson's 7% Pref.	1	7	7	36/–	—	3 17 9
Do. Ord.	1	7	8	45/–	—	3 11 1
Elec. Dis. Yorkshire	1	9	9	47/–	—	3 16 7
Elec. Fin. and Securities	1	12½	12½	3 7/8	—	3 12 9
Elec. Supply Corporation	1	11	11	64/6	—	3 8 3
Lancs Light and Power	1	7½	7½	39/–	—	3 17 0
Lond. Assoc. Electric	1	—	—	34/–	—	4 2 4
London Electric	1	7	8	40/–	—	4 0 0
London Power Deb. Red.	Stock	5	5	107½	—	4 13 0
Metropolitan	1	10	10	52/–	—	3 17 0
Midland Counties	1	7	7½	2	—	3 15 0
Mid. Elec. Power	1	8	8	41/3xd.	—3d.	3 17 7
North Eastern Electric Ordinary	1	6	6	33/–	—6d.	3 12 9
Do. 7% Pref.	1	7	7	34/6xd.	—	4 1 2
Northampton	1	10	10	52/6	—	3 16 2
Notting Hill 6% Pref.	10	6	6	14½	—	4 2 9
North Met. Elec. Ordinary	1	10	10	3	—	3 6 8
Do. do. 6% Pref.	1	6	6	32/–xd.	+6d.	3 15 0
Scottish Power	1	8	8	2 1/16	—	3 17 7
South London	1	7	7	34/6	—6d.	4 1 2
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	25/6xd.	—	5 17 8
Yorkshire Elec.	1	8	8	46/–	—	3 9 7
Public Boards.						
Central Electricity, 1950–70	Stock	5	5	116½	—	4 4 10
Do. 1955–75	„	5	5	119	—	4 4 0
Do. 1951–73	„	4½	4½	112	—	4 0 4
Do. 1963–93	„	—	3½	103	—	3 8 0
London Elec. Trans. Gtd.	„	—	2½	96½	—	2 11 10
London & Home Counties, 1955–75	„	4½	4½	112	—	4 0 4
London Passenger Transport, A...	„	—	4½	124½	—	3 12 4
Do. do. B...	„	—	5	127	—	3 18 9
Do. do. C...	„	3½	4	105	—	3 16 2
West Midlands Joint Elec. 1948–68	„	—	5	116½	—	4 5 10
Telegraph and Telephone.						
American Tel. & Tel.	$100	9	9	165½xd.	+3	5 8 9
Anglo-Am. Tel. Pref.	Stock	6	6	123½xd.	—	4 17 2
Do. Def.	„	1½	1½	29	—	5 3 5
Cable & Wireless 5½% Pref.	„	2¾	4½	107½	—	3 16 9
Do. A. 7½% Ord.	„	Nil	Nil	27	–½	—
Do. B. Ord.	„	Nil	Nil	7½	—	—
Globe Tel. & Tel. Ord.	10	2½	3½*	16	—	2 3 9
Do. do. Pref.	10	6	6	14	—	4 4 3
Great Northern Tel.	10	20	20	43	—	4 13 0
Marconi-Marine	1	10	7½	33/9	—	4 9 0
Oriental Telephone Ord.	1	12	12	3½	—	3 13 10
Home and Foregn Trams, etc.						
Anglo-Arg. Trams First Pref.	5	Nil	Nil	1/–	—3d.	—
Do. do. 2nd Pref.	5	Nil	Nil	9d.	—	—
Do. do. 5% Deb.	Stock	Nil	Nil	5	–1	—
British Electric Traction Df. Ord.	„	5	5	1525	—	—
Do. do. Pref. Ord.	„	8	8	179½	—	4 19 2
Brazil Traction	100	—	—	12⅜	–¼	—
Brit. Columbia Elec. Rly. Pce.	Stock	5	5	100½	+1	4 19 6
Mexican Light Common	100	Nil	Nil	4½	–1	—
Do. 7% Pref.	100	7	7	6½	—	—
Do. 1st Bonds	$500	5	5	57½	—	—
Victoria Falls Ord.	1	20	20	75/6	+6d.	—
West Riding	1	5	6½	52/6	—	2 9 6
Manufacturing Companies.						
Aron Electricity Ord.	1	10	15	66/3	—	4 10 7
Assoc. Elec. Ord.	1	6	8	46/6	+1/6	3 8 10
Do. Pref.	1	8	8	38/6	+6d.	4 3 1
Babcock & Wilcox	1	6	8	54/9	—3d.	2 18 5
British Aluminium Ord.	1	5	7½	41/6xd.	—2/–	3 12 4
British Insulated Ord.	1	15	20	5 7/8	+ 3/8	3 17 1
Brush Ord.	Stock	Nil	Nil	42½	—	—
Callender's	1	15	15	4½	+½	3 12 9
Do. 6½% Pref.	1	6½	6½	31/3	—	4 3 2
Crompton Parkinson Ord.	5/–	—	12½	62/6	–½	1 0 0
Do. 8% Pref.	1	8	8	38/9	—	4 2 7
Edison Swan 1st Pref.	1	7½	7½	30/–	—	5 0 0
Electric Construction	1	Nil	3½	1⅜	—	2 0 0
Enfield Cable Ord.	1	25	25	5xb.	–1/9	5 0 0
English Electric	1	Nil	Nil	1	+1/–	—
Do. do. Pref.	1	Nil	Nil	24/6	+2/–	—
Ericsson Tel.	5/–	24	20*	2 1/8	—	2 5 8
Ever Ready	5/–	35	35	24/3	—	7 4 4
Ferranti Pref.	1	7	7	26/9	—	5 4 8
G.E.C. Pref.	1	6½	6½	34/–	—	3 16 6
Do. Ord.	1	8	10	78/–	—6d.	2 11 3
Henleys	1	30	30	7½	–¼	4 2 9
Do. 4½% Pref.	5	4½	4½	5⅜	—	3 18 3
India-Rubber Preferred	1	—	5½	1½xd.	+6d.	4 17 9
Johnson & Phillips	1	5	7½	46/9	+6d.	3 4 1
Siemens Ord.	1	6½	4	27/6	—	2 18 2
Telegraph Construction	£1	Nil	Nil	27/6	—	—

* Dividends are paid free of Income Tax.

Published Specifications

Compiled expressly for this journal by a firm of chartered patent agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings will be taken.

1934

16422. "Television and like systems." Marconi's Wireless Telegraph Co., Ltd. June 1st, 1933. (443699.)

16472. "Cathode-ray tubes." Radio Akt.-Ges. D. S. Loewe. June 3rd, 1933. (Addition to 435203.) (443558.)

16694. "Protective devices for electrical apparatus." T. F. Altham, and Hackbridge Electric Construction Co., Ltd. June 5th, 1934. (443775.)

19823. "Electron-discharge amplifiers." J. D. McGee. July 5th, 1934. (443777.)

22509. "Electric incandescent lamps." A. B. Connolly. August 2nd, 1934. (443713.)

22719. "Remotely controllable radio and similar high-frequency receivers." Marconi's Wireless Telegraph Co., Ltd., N. M. Rust and J. D. Braillsford. August 3rd, 1934. (443637.)

22762. "Electric fuses." C. W. Cox. August 4th, 1934. (443717.)

24999. "Apparatus and process for the rapid development of intermediate films for television purposes." I. G. Farbenindustrie Akt.-Ges. September 26th, 1933. (443581.)

25023. "Cathode-ray tubes suitable for use for television and similar oscillograph purposes." Marconi's Wireless Telegraph Co., Ltd., and A. J. Young. August 30th, 1934. (443730.)

25024. "Radio receivers." Marconi's Wireless Telegraph Co., Ltd., and G. M. Wright. August 30th, 1934. (443582.)

25180. "High-frequency electrical transmission systems." E. L. C. White. August 31st, 1934. (443589.)

25552. "Cathode-ray tubes." J. C. Wilson and Baird Television, Ltd. September 5th, 1934. (443788.)

25582. "Electric signalling device for fencing." F. T. Eatonsore. September 5th, 1934 (443791.)

25803. "Arrangements for producing thin bundles of electron rays from large surface cathodes." C. Lorenz Akt.-Ges., and M. Von Ardenne. September 8th, 1933. (443844.)

25857. "Electric switches of the ceiling or pull-operated type." J. A. Crabtree. September 8th, 1934. (443737.)

25859. "Electrical coupling sockets." J. A. Crabtree. September 8th, 1934. (Cognate application 27014/34.) (443794.)

25998. "Electric-discharge lamps." British Thomson-Houston Co., Ltd., H. W. H. Warren, L. J. Davies and J. H. Mitchell. September 10th, 1934. (443846.)

26357. "Electric clocks." G. Briggs. September 13th, 1934. (443849.)

26469. "Mounting of electric switches and analogous articles in boxes." F. C. Blackwell & Co., Ltd., and S. D. Firth. September 14th, 1934. (443739.)

26950. "Apparatus for the rectification of polyphase alternating electric current." H. G. Kidner and Westinghouse Brake and Signal Co., Ltd. September 19th, 1934. (443650.)

27548. "Cathode-ray devices." Ferranti, Ltd., A. L. Chilcot and M. K. Taylor. September 25th, 1934. (443602.)

29256. "Electric-discharge devices." M-O Valve Co., Ltd., R. W. Rees and C. J. Smithells. October 12th, 1934. (443796.)

29671. "Electrical ceiling roses." J. A. Crabtree. October 17th, 1934. (443607.)

30518. "Device for the manufacture of electric batteries comprising a plurality of cells in end-to-end relation." R. Brandt (Dansk-Engelsk Special Maskin Kompagni Danebar.) October 24th, 1934. (443609.)

32143. "Means for obtaining a low voltage from a high-voltage electric supply system." General Electric Co., Ltd., and J. W. Gibson. November 8th, 1934. (443745.)

32267. "Cables." F. Schmidt. November 20th, 1933. (443855.)

35481. "Self-contained electric generating systems." British Thomson-Houston Co., Ltd., and R. G. Rayden. December 10th, 1934. (443746.)

1935

214. "Ultra-short wave modulating systems." L. H. Paddle. January 3rd, 1935. (443803.)

1234. "Automatic coin-operated time-control switch mechanism." Dr. L. Grünbaum. January 12th, 1934. (443747.)

1461. "Electric tumbler switches." R. Bain and N. Allday. September 4th, 1934. (Divided out of 26558/33.) (443748.)

2556. "Cathode-ray tubes." F. H. Nicoll. January 25th, 1935. (443864.)

2799. "Spark plugs." F. M. Anthony, K. C. Gillis and D. B. Edwards. January 28th, 1935. (443805.)

6772. "Adjusting or regulating arrangements for negative electric resistances." Siemens & Halske Akt.-Ges. March 2nd, 1934. (443664.)

7305. "Visual-signalling apparatus." G. T. Richards. March 8th, 1935. (443619.)

10117. "Brush holders for electric machines." Ringsdorff-Werke Akt.-Ges., and A. Stoppany. April 1st, 1935. (443810.)

14433. "Wireless apparatus." K. Schuchter. April 27th, 1934. (Divided out of 28640/34.) (Addition to 427053.) (443814.)

16610. "Loudspeakers." Denzola Lautsprecher-Fabrik Ges., and J. Lenzen. June 7th, 1935. (443816.)

19677. "Electrical switchboard devices." H. Fletcher and Central Equipment, Ltd. July 10th, 1935. (443820.)

19746. "Electric cables having corrugated aluminium sheaths." K. Jordan. July 10th, 1934. (Addition to 399066.) (443874.)

19844. "Cathode-ray tubes." British Thomson-Houston Co., Ltd. July 12th, 1934. (443682.)

21377. "Electric wave amplifying systems." Standard Telephones & Cables, Ltd. October 6th, 1934. (443684.)

21379. "Control of teleprinter motors." Creed & Co., Ltd. November 1st, 1934. (443822.)

22150. "Means for operating automatically brakes on electrically driven vehicles." H. C. Godsmark. August 6th, 1935. (443761.)

25677. "Thermionic discharge devices." British Thomson-Houston Co., Ltd. September 15th, 1934. (443767.)

25692. "Bone conduction audiphone." Dictograph Products Co., Inc. September 22nd, 1934. (443692.)

25696. "Electron-discharge device electrical oscillators." Telefunken Ges. für Drahtlose Telegraphie. September 15th, 1934. (443693.)

29021. "High-voltage electric-discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. November 14th, 1934. (443697.)

34225. "Deep sea electric cables." Siemens & Halske Akt.-Ges. January 24th, 1935. (443772.)

1936

5338. "Electric switches of the ceiling or pull-operated type." G. E. Crabtree, W. T. Elliot, E. Bradham and R. W. Thornton. (Legal representatives of J. A. Crabtree, decd.) September 8th, 1934. (Divided out of 443737.) (443774.)

Trade Mark Applications

The following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from March 25th :—

Ship. No. 560559. Class 4. Carbons for electrical purposes. —Charles H. Champion & Co., Ltd., 60-66, Wardour Street, W.1.

Thermite. No. 565716. Class 15. Globes, bowls, shades, cylinders and chimneys, all made of glass for use in connection with electric, gas and oil illumination.—R. W. Buckingham, 3, Holborn Place, High Holborn, W.C.1.

Rayweld. No. 564500. Class 18. Engineering, architectural and building contrivances.—Trevithick Weld, Ltd., 55-58, Pall Mall, S.W.1.

Harbloc. No. 566180. Class 50. Letters, numerals and shaped pieces of cellulose acetate for use in making advertising and like signs.—County Electrical Co. (Pendleton), Ltd., 26, Gravel Lane, Salford, Manchester.

The Maintenance of Hired Apparatus

Experience at Epsom

FOR the third time Lt.-Col. H. W. Watts, the electrical engineer to the Epsom and Ewell U.D.C., has compiled a very useful survey of the results obtained from the hire of electrical appliances by his department. It covers the twelve months ended June 30th, 1935, and relates to 504 electric cookers, 512 kettles, 360 irons, 62 radiators, 45 wash-boilers and 79 water heaters, all of which were in use during the whole of the year.

The report includes 503 "private" consumers, 160 on a housing estate described as all-electric and 169 on another estate. The total connected load of the appliances was 7,065 kW, giving an average of 8.5 kW per consumer. The total consumption was 1,937,734 kWh—an average of 2,329 kWh, the revenue obtained £12 4s. 3d. per consumer and the average cost of repairs £1 8s. 10d. per consumer.

The average cost of repairs for each appliance is given as follows: Cookers, £1 2s. 6d.; kettles, 4s. 10d.; irons, 10d.; radiators, 4d.; wash-boilers, 1s. 11d.; and water heaters, 3s. 9d.

In his general observations Col. Watts refers to the difficulty of keeping on circuit the black-finished cookers purchased prior to the days of the "de luxe" finish. It became necessary to halve the rental charge for them but now a firm of manufacturers has undertaken the vitreous enamelling of these cookers at a satisfactory cost. The rentals for cookers range from 6s. 3d. to 10s. 9d., according to their size and includes a 4-pint electric kettle and saucepan and a 5½-lb. iron.

Hotplates are said to be the weak point in every type of cooker—particularly the enclosed pattern plate. The manufacturers are taken to task for not taking advantage of the practical experience of the supply engineer in designing their plates and it is said that American and Canadian hotplates are superior to English makes. Col. Watts also avers that often cookers are not properly adjusted before delivery. He deprecates the frequency with which manufacturers change their standard models, leading to an increase in the number of "spares" which it is necessary to carry.

Particulars are given of the nature of the repairs carried out to each make of cooker and other appliances hired out by the department. Mention is made of some failures of the thermostats in water heaters and Col. Watts expresses a preference for the mercury type. He also says that he aims at offering for hire a 3-kW wash-boiler, with a reliable element, at 2s. per quarter or thereabouts. The report contains full details of the installation, consumption, cost of repairs, &c., for each of the 832 consumers.

New Work for Contractors

Particulars of new works and building schemes for the use of electrical installation contractors and traders

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Aberdeen.—Houses (398), Woodside; A. B. Gardner, 11, Broad Street, Aberdeen. Reconstruction of Queen's Cinema, for the Aberdeen Cinémas, Ltd. (£15,000); Rolls & Hall, architects, 146, Union Street, Aberdeen.

Ashton-under-Lyne.—Houses (20), electrical work; Messrs. Greenwood, 51, Mossley Road.

Atherton.—Houses (86), Hag Fold estate; F. L. Boydell, surveyor, Town Hall.

Aylesbury.—Cinema; A. Mather, architect, Leicester Square Chambers, Leicester Square, London, W.C.2.

Barking.—Factory (eight acres), industrial area; Nathan Cohen & Sons, Ltd.

Birkenhead.—Houses and flats, Council estates; borough engineer.

Birmingham.—Extensions to Quinton Hall Institution (£26,000); city engineer.

Bolton.—Fire station (£60,000); borough engineer.

Boston.—High school for girls (£30,000); T. F. Trower, architect, Broad Street, Spalding.

Bristol.—Combined school and maternity and child welfare clinic, Whitefield Road, Speedwell, Bristol, 1; Josiah Green, town clerk, the Council House, Bristol. Rebuilding premises, Castle Green; Marks & Spencer, Ltd.

Brownhills (STAFFORDSHIRE).—Houses (200); U.D.C. surveyor.

Brynmawr.—Houses (40); J. J. Quirk, U.D.C. surveyor.

Bursiem.—Houses (145), Dairyfields estate, Sneyd Green; Leake & Co. Church, Waterloo Road; Rev. Faulconer Morgan. Reconstruction of Palace Cinema, Cleveland Street; W. Hitchen.

Caerphilly.—Houses (22), Trecenydd and Taff's Well; U.D.C. housing officer.

Cambridgeshire.—School, Swavesey, for County E.C.; county architect, Shire Hall, Cambridge.

Chelmsford.—Extensions to factory, Cottage Place; J. Macpherson & Co., Ltd.

Chorley.—Cinema (1,200 seats), Union Street and High Street, for the Odeon Theatres, Ltd.; H. Weedon, architect, 84, Colmore Row, Birmingham.

Darlington.—Houses (66), Harrowgate Hill; borough surveyor. Cinema (2,000 seats), Bondgate; P. L. Browne & Sons, architects, Newcastle-on-Tyne. Completion of Eastbourne school (£21,000); E. Minors, borough engineer.

Doncaster.—Grammar school, for Borough E.C.; G. R. H. Danby, secretary.

Edinburgh.—Intermediate school, Craigmillar; Reid and Forbes, architects, Edinburgh. School, Pilton district; city architect.

Essex.—Extensions to Wanstead High School (£21,792) and senior school, Aveley (£28,726), for County E.C.; J. Stuart, county architect, Chelmsford.

Fenton (STAFFORDSHIRE).—Houses (34), Regent Road; Albert Bates.

Friern Barnet.—Houses, St. James' Avenue; Church Farm Estates, Ltd.

Goole.—Factory, Hook, for A. L. & P. Ingleby.

Gravesend.—Senior school (£18,600), for the Church of England managers; secretary.

Haltwhistle.—Houses (27), Greencroft; Edward Matthews, builder, 32, North Seaton Road, Newbiggin, Northumberland.

Hastings.—School, Hollington; director of education.

Hebburn-on-Tyne.—Senior school; T. A. Page & Son, architects, 67, King Street, South Shields.

High Wycombe (BUCKINGHAMSHIRE).—Cinema, for A. E. Abrahams, Ltd., 25, Shaftesbury Avenue, London, W. Factory; W. Birch, Ltd.

Holmfirth (YORKSHIRE).—Houses and bungalows (electrical work); J. Ainley, architect, 25, Market Street, Huddersfield.

Hyde.—Houses (114), Dukinfield Road, Victoria Street sites; J. H. Ward, borough surveyor, Town Hall, Hyde.

Ipswich.—Junior school, Greenwich estate; Sadler & Sons.

Irish Free State.—(GOREY, CO. WEXFORD).—District hospital, for the Wexford Board of Health; O'Sullivan & Jordan, architects, Grafton Street, Dublin.

Kent.—Radiography and receiving block, Pembury hospital, for C.C.; W. H. Robinson, county architect, Maidstone.

Kingston-on-Thames.—Public baths (£51,986); Limpus and Sons, Ltd., builders.

Lancaster.—Transport depôt, Caton Road (£15,542); R. L. Dilworth, Ltd.

Leeds.—Cinema, York Road, for Goldstone (Cinemas), Ltd.; J. Brodie, architect, 2, Lidget Hill, Pudsey. Hotel, Amberton Road, Gipton; Pennington, Hustler & Taylor, architects, Pontefract. Two senior schools, Sandford housing estate; city architect.

Liverpool.—Central library, Ashton Street, for University of Liverpool (£100,000); Joshua Henshaw & Sons, builders, Chatham Street, Liverpool. Girls' secondary school, Childwall Valley Road, for City E.C. Elementary school, Duncombe Road area, for E.C.

Llandudno.—Hospital; R. Norman Mackellar, architectural assessor, Newcastle-on-Tyne.

London.—(HOLLOWAY).—Rebuilding and extensions to Royal Northern Hospital (£212,000); governors. (POPLAR).—Extension to factory, Old Ford Road; C. Yates & Co., 106, Campbell Road, E.3. Redevelopment of Bow Road (£81,000); L.C.C. architect. (SOUTHWARK).—Tenements, Tarn Street (£42,270); Rowley Bros., Ltd., Tower Works, Dunloe Avenue, N.17. (WESTMINSTER).—Buildings, Endell Street and Wilson Street; Yates, Cook & Darbyshire, 43, Great Marlborough Street, W.1. Offices and shops, Gillingham Street and Wilton Road; Forbes & Tate, 35, Bruton Street, W.1. Shops and flats, Curzon Street and Clarges Street; T. P. Bennett & Son, 43, Bloomsbury Square, W.C.1. Extensions to 7-9, St. George's Square; Civil Service Housing Association, Ltd., 9, Dartmouth Street, S.W.1. Reconstruction of premises, Swallow Place; Jays, Ltd., Regent Street, W.1. (EAST HAM).—Houses, Langdon Road; R. J. L. Slater, 199, Plashet Grove, E.6.

Maidstone.—Business stores, Week Street, for T. P. Caffyn & Co., Ltd.

Manchester.—Houses (1,018), Crossacres estate (£357,408), fire station, Withington (£16,375), and schools, Bowker Vale, Abbey Hey and Moston Fields; city architect. Houses (30), Moorlands estate, Fog Lane, Didsbury; W. R. Parkinson, builder, 4, Chapel Walks, Manchester

Mansfield.—Houses (63), by direct labour, slum areas (£19,000); borough engineer.

Meir (STAFFORDSHIRE).—Houses (385), near Uttoxeter Road; F. Gibson.

Middlesbrough.—Houses (31), Newham Avenue and Tollesby Road; Archibald & Archibald, architects, 26, Albert Road. Junior instruction centre, Lansdowne Street, for E.C.; P. B. Haswell, architect, Education Offices, Woodlands Road.

Morecambe.—Houses (193), Newtown estate; Harrison & Moore. Extensions to Elms Hotel; Glendenning & Hanson.

Newcastle-on-Tyne.—Cinema, Armstronge Road, for E. J. Hinge, Ltd., Grey Street; P. L. Browne & Sons, architects, Pearl Buildings, Northumberland Street. Garage, Sandyford Road, for the Elswick Investment Trust, Ltd.; H. Wylie, architect, 24, Bideford Gardens, Low Fell, Gateshead-on-Tyne.

North Riding.—School, Loftus-in-Cleveland; county director of education, Northallerton.

Northern Ireland. — (MAGHERAFELT). — Public elementary school, Aughrim; R. T. M'Guckin, architect, Garden Street.

Northumberland.—Schools, Tweedmouth (£24,000), Cornhill (£11,750), and Stannington; W. W. Tasker, county architect, County Hall, Newcastle-on-Tyne.

Oxford.—Cinema, St. Aldate's, for Associated British Cinemas, Ltd.

Penmaenmawr.—Cinema (electrical work), J. Isgoed Williams, architect, Llanfairfechan.

Portsmouth.—Premises for aged and infirm people (£69,300), for P.A.C.; city architect.

Rotherham.—Offices, laboratories and testing room, Westgate, for Rotherham Steel Strip Co., Ltd., Bath Works, Westgate; W. Blair, builders, Davis Street, Rotherham.

Royton (LANCASHIRE).—Houses (36), Royley site; U.D.C. surveyor.

Scarborough.—Houses (92), Northstead estate; borough surveyor.

Seaham Harbour.—Houses (250); U.D.C. surveyor.

Sheffield.—Houses (22), Button Hill; Cussins, Ltd. Houses for the aged, and school and clinic, Eastern Avenue; city architect. Houses (44), Handsworth Avenue; W. & E. Sadler, Ltd. Factory, Bowling Green Street, for Lewis Rose & Co., Ltd., Mappin Buildings, Norfolk Street; Abbott & Bannister, Ltd., builders, Machon Bank, Sheffield, 7. Nine-storey building containing flats, swimming pool, tennis courts, bowling green, &c., Bradfield Road, for A. Krausz, 9, Wilkinson Street, Sheffield; Joseph Foster (Yorks), Ltd., builders, Duke Street, Sheffield.

Shifnal (SHROPSHIRE).—Houses (82); J. France & Sons, Trench, A. Mason, Albrighton, and W. A. Sherratt, Church Stretton.

Smethwick.—Extensions to works, Halfords Lane; Henry Hope & Sons, Ltd. Extensions to works, Mafeking Road; Aga Heat, Ltd.

Stockport.—Houses (78), Heath Park estate, Cheadle Heath; A. Allen (Builders), Ltd., Springbridge Road, Moss Side, Manchester.

Stoke-on-Trent.—Houses, Radford Road; G. H. Broad.

Sunderland.—Houses (500), Hylton Lane estate; borough engineer.

Swadlincote.—Covered market; U.D.C. surveyor.

Swansea.—Houses (200), Town Hill; borough architect.

Swinton (YORKSHIRE).—Extensions to Wath Wood Hospital, for the Joint Hospital Board; James Totty, architect, Moorgate Street, Rotherham.

Teddington.—Estate development near Broom Road; Thomas & Son, Chipstead. Factory and office, Kingston Road; Gay Bros.

Trowbridge.—Cinema, for the Gaumont-British Picture Corporation, Ltd., Film House, Wardour Street, London, W.1.

Tunbridge Wells.—Assembly hall, police court and station (£97,289); borough surveyor.

Twickenham.—Houses (316), Meadway, for Wates (Malden), Ltd.

Tynemouth.—Houses (26), Ridges estate, and ward buildings, Moor Park Isolation Hospital (£23,200); D. M. O'Herlihy, borough engineer, 19, Howard Street, North Shields.

Urmston.—Houses (48), Hawthorn Farm estate; Freeman, Evans & Co., builders, 14, Edge Lane, Stretford.

Warrington.—Grammar school, for Borough E.C.; J. Y. Hughes, borough surveyor.

Washington (CO. DURHAM).—Alterations to Globe Cinema; E. M. Lawson, architect, Barras Buildings, Barras Bridge, Newcastle-on-Tyne.

Wellington (SHROPSHIRE).—Cinema, electrical work, Bridge Road, for Craven Cinemas, Ltd.

West Bromwich.—Cinema, Walsall Road; Rosumclift Cinemas, Ltd.

West Sussex.—Police station and school (1,344 places), Bognor Regis, for C.C.; C. G. Stillman, county architect, Chichester.

Wrexham.—Houses (400); R.D.C. surveyor.